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Atty: Glenn J. Perry/nlh

Appln. No: UNASSIGNED Date: December 22, 2003

Inventors: AKIHIRO OZEKI ET AL.

Title: Electronic Apparatus System, And Operation Control Method

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Other:

CURRENT DUE DATE: January 10, 2004

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TITLE OF THE INVENTION

ELECTRONIC APPARATUS SYSTEM, AND OPERATION CONTROL METHOD

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is based upon and claims the benefit of priority from the prior Japanese Patent Application No. 2003-004369, filed January 10, 2003, the entire contents of which are incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an operation control technique of an electronic apparatus system which can operate using, e.g., a direct methanol fuel cell as a power supply.

2. Description of the Related Art

In recent years, various portable electronic apparatus such as a portable information terminal called a PDA (Personal Digital Assistant), digital camera, and the like, which can be driven by a battery, have been developed and are prevalent.

Also, recently, environmental problems are widely recognized, and the development of environment-friendly batteries has been extensively made. As a battery of this type, a direct methanol fuel cell (to be abbreviated as DMFC hereinafter) is well known.

This DMFC produces electrical energy by chemical

reaction of methanol as fuel and oxygen. The DMFC has a structure in which two electrodes made up of a porous metal or carbon sandwich an electrolyte (e.g., Hironosuke Ikeda, "All About Fuel Cells", NIPPON JITSUGYO PUBLISHING, CO., LTD., August 20, 2001, pp. 216 - 217). Since this DMFC does not produce any hazardous waste, its practical application is strongly demanded.

The DMFC requires an auxiliary mechanism such as a pump or the like to increase the output electric power per unit volume. However, since electric power that can be produced by the DMFC depends on the temperature in a cell stack, even after the auxiliary mechanism works to supply fuel and air (oxygen) into the cell stack, no load can be connected until the temperature in the cell stack reaches a predetermined value. That is, in an electronic apparatus system that operates using the DMFC as a power supply, control that not only recognizes the ON/OFF state of the operation of the DMFC but also considers its operation state is required.

Since the DMFC normally comprises a fuel tank that stores fuel as a cartridge, control that considers attachment/detachment of this fuel tank and the remaining fuel amount is also required.

Furthermore, when a secondary battery such as a lithium battery or the like is used in combination so

as to assure electric power upon starting up the auxiliary mechanism of the DMFC and to cope with a load peak, control that considers the state of this secondary battery is required.

BRIEF SUMMARY OF THE INVENTION

According to an embodiment of the present invention, an electronic apparatus system comprises a cell unit which has a fuel cell that can produce electricity by chemical reaction, and an output unit that outputs state information of the fuel cell, and

an electronic apparatus which can operate based on electric power produced by the cell unit, and has a control unit that executes operation control on the basis of the state information output from the output unit.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

The accompanying drawings, which are incorporated in and constitute a part of the specification, illustrate presently preferred embodiments of the invention, and together with the general description given above and the detailed description of the preferred embodiments given below, serve to explain the principles of the invention.

FIG. 1 shows the outer appearance of an electronic apparatus system according to an embodiment of the present invention;

FIG. 2 is a schematic block diagram showing the

arrangement of a fuel cell unit applied to the electronic apparatus system according to the embodiment of the present invention;

FIG. 3 is a schematic block diagram showing the arrangement of an electronic apparatus applied to the electronic apparatus system according to the embodiment of the present invention;

FIGS. 4A and 4B are a table showing an example of state information associated with the state of a DMFC, which is exchanged between the fuel cell unit and electronic apparatus applied to the electronic apparatus system according to the embodiment of the present invention;

FIGS. 5A and 5B are a table showing an example of state information associated with the state of a secondary battery, which is exchanged between the fuel cell unit and electronic apparatus applied to the electronic apparatus system according to the embodiment of the present invention;

FIG. 6 is a table showing the drive control of LEDs, which is executed by a power supply controller of the electronic apparatus applied to the electronic apparatus system according to the embodiment of the present invention on the basis of the state information; and

FIG. 7 is a flowchart showing the operation sequence associated with power supply control of

electronic apparatus system according to the embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Embodiments of the present will be described hereinafter with reference to the accompanying drawings.

FIG. 1 shows the outer appearance of an electronic apparatus system according to an embodiment of the present invention.

As shown in FIG. 1, an electronic apparatus system of this embodiment comprises an electronic apparatus 1 and a fuel cell unit 2 which is detachable from the electronic apparatus 1. The electronic apparatus 1 is a notebook type personal computer which is formed by attaching via a hinge mechanism a lid unit which has an LCD (Liquid Crystal Display) on its inner surface to a main body unit to freely open/close. The electronic apparatus 1 can operate by electric power supplied from the fuel cell unit 2. Two LEDs (Light Emitting Diodes; not shown) are provided to the front surface of the main body unit of this electronic apparatus 1, i.e., a nearly vertical surface which is exposed even when the lid unit is closed.

On the other hand, the fuel cell unit 2 incorporates a DMFC that can produce electricity by chemical reaction, and a rechargeable secondary battery. FIG. 2 is a schematic block diagram showing

the arrangement of this fuel cell unit 2.

As shown in FIG. 2, the fuel cell unit 2 comprises a microcomputer 21, DMFC 22, secondary battery 23, charge circuit 24, and supply control circuit 25.

The microcomputer 21 controls the operation of the overall fuel cell unit 2, and has a communication function of exchanging signals with the electronic apparatus 1. The DMFC 22 has a detachable cartridge type fuel tank 221. The DMFC 22 outputs electric power produced upon chemical reaction between methanol stored in this fuel tank 221 and air (oxygen). This chemical reaction is made in a reactor called a cell stack. In order to efficiently supply methanol and air to this cell stack, the DMFC 22 comprises an auxiliary mechanism such as a pump and the like. The DMFC 22 has a mechanism which informs the microcomputer 21 of attachment/detachment of the fuel tank 221, the remaining methanol amount in the fuel tank 221, the operation state of the auxiliary mechanism, and the current output electric power.

The secondary battery 23 accumulates electric power output from the DMFC 22 via the charge circuit 24, and outputs the accumulated electric power in accordance with an instruction from the microcomputer 21. The secondary battery 23 comprises an EEPROM 231 that holds basic information indicating its discharge characteristics and the like. The EEPROM

231 can be accessed by the microcomputer 21. The secondary battery 23 has a mechanism that informs the microcomputer 21 of the current output voltage and current values. The microcomputer 21 calculates the remaining battery amount of the secondary battery 23 on the basis of the basic information read out from the EEPROM 231, and the output voltage and current values sent from the secondary battery. Assume that the secondary battery 23 is a lithium battery (LIB).

The charge circuit 24 charges the secondary battery 23 using electric power output from the DMFC 22, and the ON/OFF state of its charge process is controlled by the microcomputer 21. The supply control circuit 25 externally outputs electric power of the DMFC 22 and secondary battery 23 as needed.

FIG. 3 is a schematic block diagram showing the arrangement of the electronic apparatus 1.

As shown in FIG. 3, the electronic apparatus 1 comprises a CPU 11, main memory (RAM) 12, HDD 13, display controller 14, keyboard controller 15, and power supply controller 16, which are connected to a system bus.

The CPU 11 controls the operation of the overall electronic apparatus 1, and executes various programs stored in the main memory 12. The RAM 12 is a storage medium serving as a main storage of this electronic apparatus 1, and stores various programs to be executed

by the CPU 11 and various data used by these programs. On the other hand, the HDD 13 is a storage medium serving as an external storage of this electronic apparatus 1, and stores various programs and various data in large quantities as an auxiliary unit of the RAM 12.

The display controller 14 is responsible for the output side of a user interface of this electronic apparatus 1, and controls an LCD 141 to display image data generated by the CPU 11. On the other hand, the keyboard controller 15 is responsible for the input side of the user interface of the electronic apparatus 1. The keyboard controller 15 converts operations of a keyboard 151 and pointing device 152 into numerical values, and passes them to the CPU 11 via internal registers.

The power supply controller 16 controls power supply to the respective units in the electronic apparatus 1. The power supply controller 16 has a power reception function of receiving power supply from the fuel cell unit 2, and a communication function of exchanging signals with the fuel cell unit 2. The partner on the fuel cell unit 2 side, with which the power supply controller 16 exchanges signals is the microcomputer 21 shown in FIG. 2. The electronic apparatus system is characterized in that the states of the DMFC 22 and secondary battery 23 incorporated in

the fuel cell unit 2 are sent to the electronic apparatus 1 as state information via communications between the microcomputer 21 of the fuel cell unit 2 and the power supply controller 16 of the electronic apparatus 1, and the electronic apparatus 1 can execute operation control based on the received states. Such characteristic feature will be described in detail below. Note that the two LEDs provided to the front surface of the main body unit of the electronic apparatus 1 include an LED 161 used to inform the state of the DMFC 22, and an LED 162 used to inform the state of the secondary battery 23. These LEDs undergo display control of the power supply controller 16.

FIGS. 4A, 4B and 5A, 5B show examples of state information exchanged between the fuel cell unit 2 and electronic apparatus 1 in this electronic apparatus system. FIGS. 4A and 4B show state information associated with the state of the DMFC 22, and FIGS. 5A and 5B show state information associated with the state of the secondary battery 23.

As shown in FIGS. 4A and 4B, the microcomputer 21 of the fuel cell unit 2 sends two different states to the power supply controller 16 of the electronic apparatus 1, i.e., the state of the fuel tank 221 and the operation state of the DMFC 22 as state information associated with the state of the DMFC 22.

In order to send the state of the fuel tank 221 as

state information, the microcomputer 21 monitors attachment/detachment of the fuel tank 221 and the remaining fuel amount in the attached fuel tank 221. The microcomputer 21 sends the following state information to the power supply controller 16 of the electronic apparatus 1 in accordance with the monitor result.

(A1) NORMAL: The fuel tank 221 is attached, and its remaining fuel amount is sufficient.

(A2) LOW: The fuel tank 221 is attached, but its remaining fuel amount is insufficient.

(A3) CRITICAL: The fuel tank 221 is attached, but its remaining fuel amount is zero, and fuel remains in only the cell stack of the DMFC 22.

(A4) EMPTY: The fuel tank 221 is attached, but its remaining fuel amount is zero, and no fuel remains in only the cell stack of the DMFC 22.

(A5) None_CRITICAL: Fuel remains in the cell stack of the DMFC 22, but no fuel tank 221 is attached (the fuel tank 221 is removed during operation of the DMFC 22).

(A6) None_EMPTY: No fuel tank 221 is attached (the DMFC 22 is OFF).

(A7) Abnormal state: The fuel tank 221 suffers some abnormality.

Also, the microcomputer 21 sends the following state information to the power supply controller 16 of

the electronic apparatus 1 as the operation state of the DMFC 22.

(B1) Operation OFF: The DMFC 22 is OFF (the auxiliary mechanism is OFF).

(B2) WARMUP: The auxiliary mechanism is active, but the rated output of the DMFC 22 is not guaranteed yet (the state immediately after the DMFC 22 begins to operate).

(B3) Operation ON: The DMFC 22 is normally operating (the auxiliary mechanism is active).

(B4) Abnormal state: The DMFC 22 suffers some abnormality.

Furthermore, as shown in FIGS. 5A and 5B, the microcomputer 21 sends the following state information to the power supply controller 16 of the electronic apparatus 1 as that which is associated with the state of the secondary battery 23.

(C1) Over discharge 1: Over discharge is detected, and an electric power output is cut off.

(C2) Over discharge 2: The secondary battery 23 suffers a low-battery state.

(C3) LOWBAT: The remaining battery amount required to assure the system operation of the electronic apparatus 1 cannot be guaranteed.

(C4) NORMAL: The remaining battery amount required to assure the system operation of the electronic apparatus 1 can be guaranteed (other than

the fully charged state).

(C5) FULLBAT: The remaining battery amount required to assure the system operation of the electronic apparatus 1 can be guaranteed, and the fully charged is set.

(C6) Overvoltage: An overvoltage is detected, and a charge process is inhibited.

(C7) Abnormal state: A charge current is abnormal or a discharge current without any load is abnormal.

Since various kinds of state information mentioned above are sent from the microcomputer 21 of the fuel cell unit 2 to the power supply controller 16 of the electronic apparatus 1, the electronic apparatus 1 can execute operation control that considers the characteristics unique to the DMFC 22. More specifically, the electronic apparatus 1 can, e.g., start the system after it waits until the rated output of the DMFC 22 can be guaranteed in place of starting the system simultaneously with the start of operation of the DMFC 22.

FIG. 6 shows the drive control of the LEDs 161 and 162, which is executed by the power supply controller 16 on the basis of the state information sent from the microcomputer 21 of the fuel cell unit 2.

The power supply controller 16 executes the drive control of the LED 161 used to inform the state of the DMFC 22 as follows.

(A1) OFF: The DMFC 22 is OFF, i.e., "Operation OFF" is received as state information associated with the state of the DMFC 22.

(A2) Green blinking: The DMFC 22 is warming up, i.e., "WARMUP" is received as state information associated with the state of the DMFC 22.

(A3) Green ON: The DMFC 22 is operating, i.e., "Operation ON" is received as state information associated with the state of the DMFC 22.

(A4) Orange blinking: The DMFC 22 is abnormal, i.e., "Abnormal state" is received as state information associated with the state of the DMFC 22.

The power supply controller 16 also executes the drive control of the LED 162 used to inform the state of the secondary battery 23 as follows.

(B1) OFF: The DMFC 22 is OFF, i.e., the secondary battery 23 is abnormal or is inhibited from being charged. That is, "Operation OFF" is received as state information associated with the state of the DMFC 22, or "Abnormal state" or "Overvoltage" is received as state information associated with the state of the secondary battery 23.

(B2) Orange blinking: One of conditions other than "OFF" is met, i.e., the electric power output of the secondary battery 23 is cut off due to over discharge detection, the secondary battery 23 suffers a low-battery state, or the secondary battery cannot

guarantee the remaining battery amount required to assure the system operation of the electronic apparatus 1. That is, "Over discharge 1", "Over discharge 2", or "LOWBAT" is received as state information associated with the state of the secondary battery 23.

(B3) Orange flash: One of conditions other than "OFF" is met, i.e., the electric power output of the secondary battery 23 is cut off due to over discharge detection, or the secondary battery 23 suffers a low-battery state, and the startup operation of the DMFC 22 has been made. That is, "Over discharge 1" or "Over discharge 2" is received as state information associated with the state of the secondary battery 23, and "Abnormal state" is received as state information associated with the state of the DMFC 22.

(B4) Orange ON: A condition other than "OFF" is met, i.e., the secondary battery 23 can guarantee the remaining battery amount required to assure the system operation of the electronic apparatus 1 (other than the fully charged state). That is, "NORMAL" is received as state information associated with the state of the secondary battery 23.

(B5) Green ON: A condition other than "OFF" is met, i.e., the secondary battery 23 can guarantee the remaining battery amount required to assure the system operation of the electronic apparatus 1, and the fully

charged state is set. That is, "FULLBAT" is received as state information associated with the state of the secondary battery 23.

By executing the drive control of the LEDs 161 and 162, as described above, the system can inform the user of the states of the DMFC 22 and secondary battery 23 incorporated in the fuel cell unit 2 as needed.

FIG. 7 is a flowchart showing the operation sequence associated with the power supply control of the electronic apparatus system of this embodiment.

The microcomputer 21 of the fuel cell unit 2 monitors the states of the DMFC 22 and secondary battery 23 (step A1) to check if the states have changed (step A2). If the states have changed (YES in step A2), the microcomputer 21 sends state information indicating the current states of the DMFC 22 and secondary battery 23 to the power supply controller 16 of the electronic apparatus 1 (step A3).

The power supply controller 16 waits to receive the state information from the microcomputer 21 of the fuel cell unit 2 (step B1). Upon reception of some state information (YES in step B1), the power supply controller 16 analyzes the received state information (step B2). The power supply controller 16 executes the operation control of the electronic apparatus 1 on the basis of the analysis result (step B3).

As described above, the electronic apparatus

system of this embodiment informs the electronic apparatus 1 of the states of the DMFC 22 and secondary battery 23 incorporated in the fuel cell unit 2 as state information via communications between the microcomputer 21 of the fuel cell unit 2 and the power supply controller 16 of the electronic apparatus 1. Thus, the electronic apparatus 1 can execute the operation control based on the received states.

In the aforementioned embodiment, the fuel cell unit 2 incorporates two different types of batteries, i.e., the DMFC 22 and secondary battery 23. However, the present invention is effective even when the fuel cell unit 2 incorporates the DMFC 22 alone.

Additional advantages and modifications will readily occur to those skilled in the art. Therefore, the invention in its broader aspects is not limited to the specific details and representative embodiments shown and described herein. Accordingly, various modifications may be made without departing from the spirit or scope of the general inventive concept as defined by the appended claims and their equivalents.

WHAT IS CLAIMED IS:

1. An electronic apparatus system comprising:

a cell unit which has a fuel cell that can produce electricity by chemical reaction, and an output unit that outputs state information of the fuel cell; and

an electronic apparatus which can operate based on electric power produced by the cell unit, and has a control unit that executes operation control on the basis of the state information output from the output unit.

2. The electronic apparatus system according to claim 1, wherein the fuel cell comprises:

a reactor which produces electric power by chemical reaction; and

a fuel tank which is detachably provided to the fuel cell, and stores fuel which is to be supplied to the reactor and is required for the chemical reaction, and

the output unit outputs information indicating attachment/detachment of the fuel tank as the state information.

3. The electronic apparatus system according to claim 2, wherein the output unit outputs information indicating a remaining fuel amount in the fuel tank as the state information.

4. The electronic apparatus system according to claim 1, wherein the output unit outputs, as the state

information, information indicating one of an inactive state in which the reactor does not make chemical reaction, a state in which the reactor produces electric power, but a rated output cannot be guaranteed, and a state in which the reactor produces electric power, and the rated output can be guaranteed.

5. An electronic apparatus system comprising:

a cell unit which has a fuel cell that can produce electricity by chemical reaction, and an output unit that outputs state information of the fuel cell; and

an electronic apparatus which can operate based on electric power produced by the cell unit, and has an informing unit that can inform the state of the cell unit on the basis of the state information output from the output unit.

6. An electronic apparatus system comprising:

a cell unit which has a fuel cell that can produce electricity by chemical reaction, a rechargeable secondary battery, and an output unit that outputs state information of the fuel cell and the secondary battery; and

an electronic apparatus which can operate based on electric power produced by the cell unit and supplied by the secondary battery, and executes operation control on the basis of the state information output from the output unit.

7. The electronic apparatus system according to

claim 6, wherein the fuel cell comprises:

a reactor which produces electric power by chemical reaction; and

a fuel tank which is detachably provided to the fuel cell, and stores fuel which is to be supplied to the reactor and is required for the chemical reaction, and

the output unit outputs information indicating attachment/detachment of the fuel tank as the state information.

8. The electronic apparatus system according to claim 7, wherein the output unit outputs information indicating a remaining fuel amount in the fuel tank as the state information.

9. The electronic apparatus system according to claim 6, wherein the output unit outputs, as the state information, information indicating one of an inactive state in which the reactor does not make chemical reaction, a state in which the reactor produces electric power, but a rated output cannot be guaranteed, and a state in which the reactor produces electric power, and the rated output can be guaranteed.

10. The electronic apparatus system according to claim 6, wherein the output unit outputs a remaining battery amount of the secondary battery as the state information.

11. An electronic apparatus system comprising:

a cell unit which has a fuel cell that can produce electricity by chemical reaction, a rechargeable secondary battery, and an output unit that outputs state information of the fuel cell and the secondary battery; and

an electronic apparatus which can operate based on electric power produced by the cell unit, and has an informing unit that can inform the state of the cell unit on the basis of the state information output from the output unit.

12. An operation control method for an electronic apparatus system which includes a cell unit which incorporates a fuel cell that can produce electricity by chemical reaction, and an electronic apparatus which can operate by electric power supplied from the cell unit and has an informing unit, comprising:

transmitting state information to the electronic apparatus by the cell unit, when a state of the fuel cell has changed; and

informing the state of the cell unit via the informing unit in accordance with the state information received from the cell unit by the electronic apparatus.

13. The operation control method according to claim 12, wherein the state information is information indicating attachment/detachment of a fuel tank which stores fuel that is supplied to a reactor and is

required for the chemical reaction.

14. The operation control method according to claim 12, wherein the state information is information indicating a remaining amount of the fuel tank.

15. The operation control method according to claim 12, wherein the cell unit further comprises a secondary battery, and

the state information is information indicating a remaining amount of the secondary battery.

ABSTRACT OF THE DISCLOSURE

An electronic apparatus system of this invention includes an electronic apparatus, and a fuel cell unit which is detachable from the electronic apparatus. The fuel cell unit incorporates a DMFC that can produce electricity by chemical reaction, and a rechargeable secondary battery. The fuel cell unit has a function of informing the electronic apparatus of the states of the DMFC and secondary battery incorporated in it as state information. The electronic apparatus has a function of executing its operation control on the basis of the state information sent from the fuel cell unit.

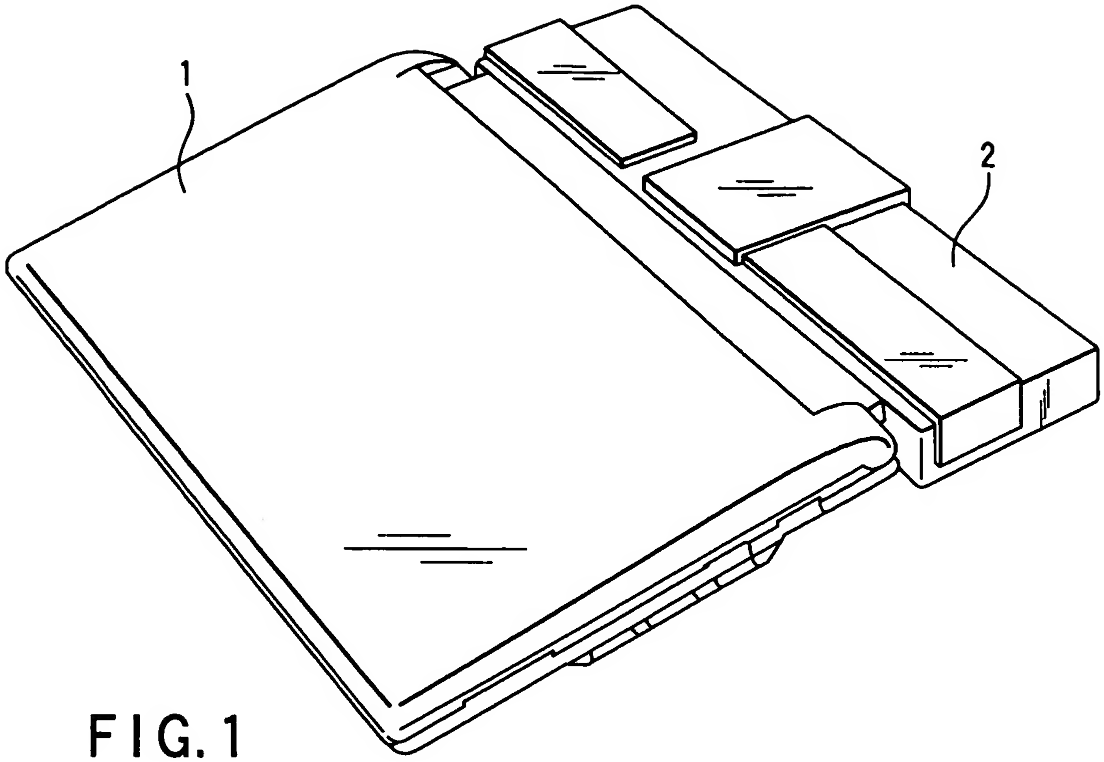
1
2

FIG. 1

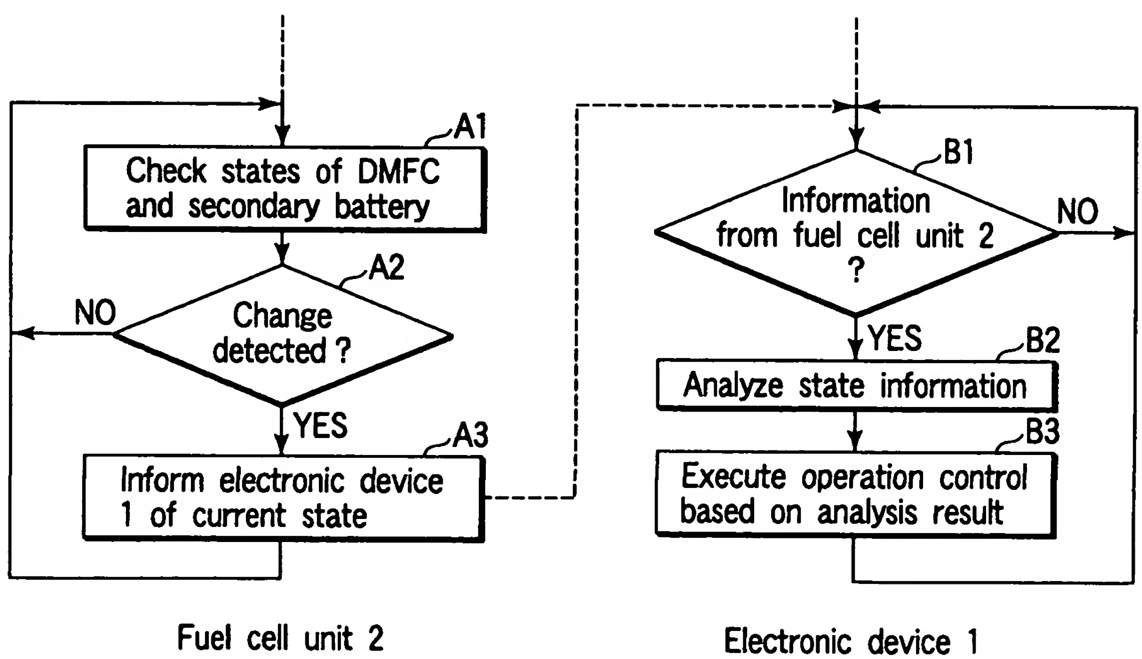
A1
Check states of DMFC and secondary battery
A2
Change detected ?
NO
YES
A3
Inform electronic device 1 of current state
B1
Information from fuel cell unit 2 ?
NO
YES
B2
Analyze state information
B3
Execute operation control based on analysis result
Fuel cell unit 2
Electronic device 1

FIG. 7

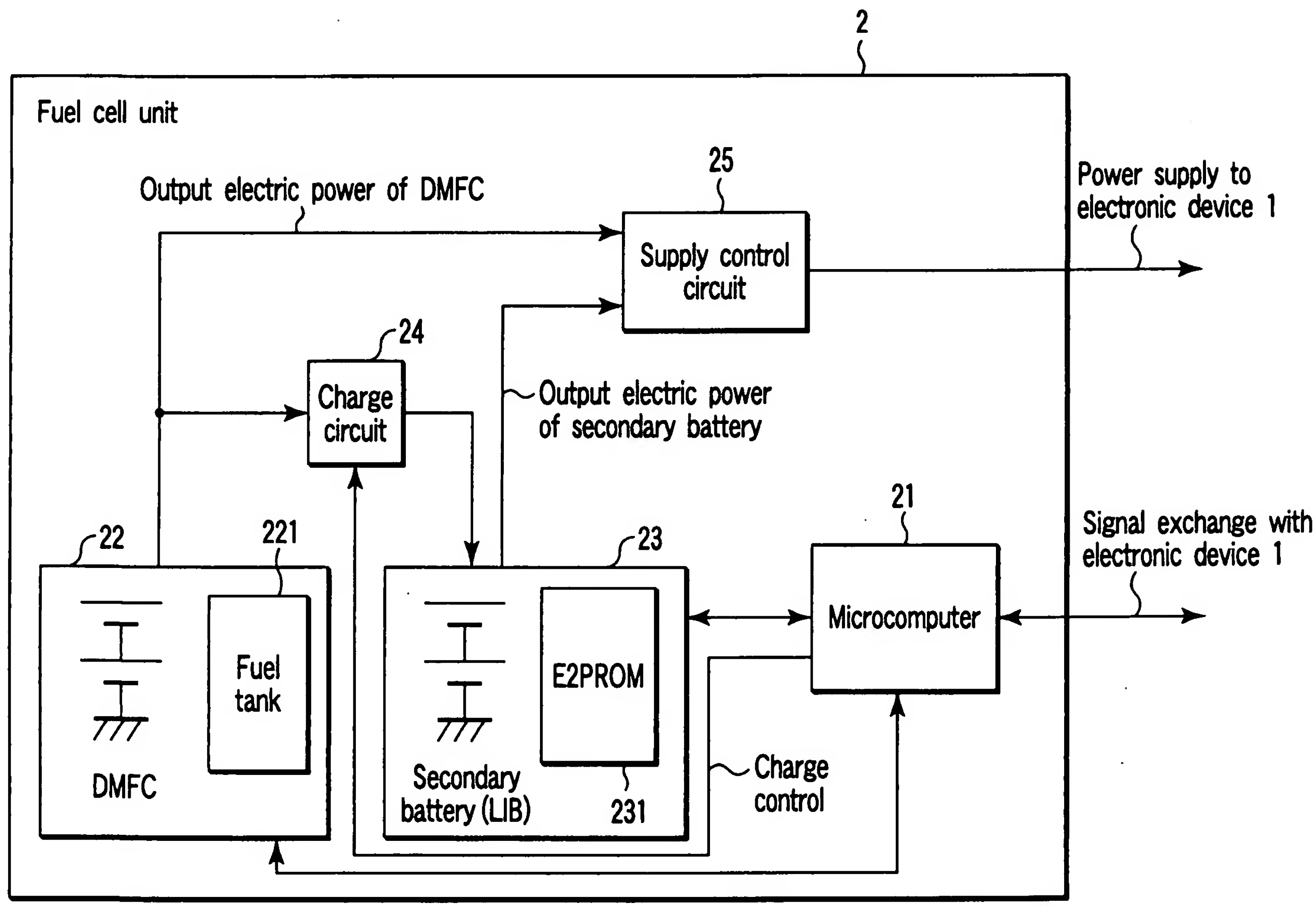
2
Fuel cell unit
Output electric power of DMFC
25
Supply control circuit
Power supply to electronic device 1
24
Charge circuit
Output electric power of secondary battery
21
Signal exchange with electronic device 1
22
221
23
Microcomputer
Fuel tank
E2PROM
DMFC
Secondary battery (LIB)
231
Charge control

FIG. 2

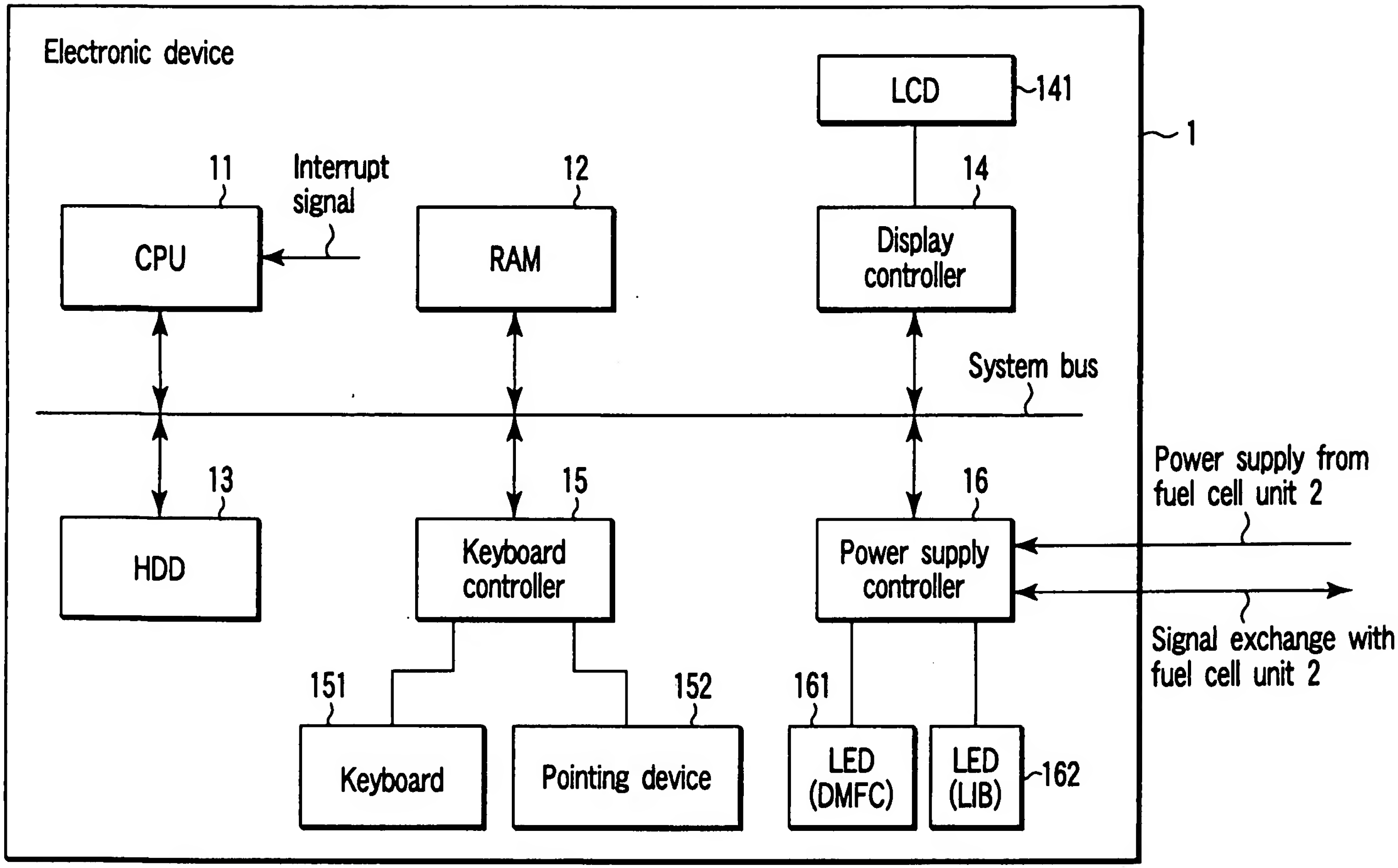
Electronic device
1
CPU
11
Interrupt signal
RAM
12
LCD
141
Display controller
14
System bus
HDD
13
Keyboard controller
15
Power supply controller
16
Power supply from fuel cell unit 2
Signal exchange with fuel cell unit 2
Keyboard
151
Pointing device
152
LED (DMFC)
161
LED (LIB)
162

FIG. 3

	State	Definition
DMFC (Fuel Tank)	Normal	Cartridge is connected, and remaining fuel amount can assure DMFC normal operation (WarmUp/Operation ON) DMFC state transition -Operation OFF → WarmUp = OK -WarmUp → Operation ON = OK During DMFC Operation ON -System power supply = OK -LIB charge = OK
	Low	Cartridge is connected, and remaining fuel amount that assures DMFC normal operation (WarmUp/Operation ON) is 1% DMFC state transition -Operation OFF → WarmUp = OK -WarmUp → Operation ON = OK During DMFC Operation ON -System power supply = OK (inform user of remaining amount = Low) -LIB charge = OK
	Critical	Cartridge is connected, but remaining fuel amount in cartridge is 0% and fuel remains in only DMFC DMFC state transition -Operation OFF → WannUp = OK -WarmUp → Operation ON = OK During DMFC Operation ON -System power supply = OK (system OFF request) -LIB charge = NG
	Empty	Cartridge is connected, but fuel remains in neither cartridge nor DMFC DMFC state transition -Operation OFF → WarmUp = NG (no transition from Operation OFF) -WarmUp → Operation ON = NG (transition from Warmup to Operation OFF) During DMFC Operation ON -System power supply = NG -LIB charge = NG

F I G. 4A

	None_ Critical	Since cartridge is removed during DMFC normal operation (WarmUp/Operation ON), fuel remains in only DMFC This condition is met only when cartridge is removed during DMFC normal operation (WarmUp/Operation ON) -System power supply = OK (system OFF request) -LIB charge = NG
	None_ Empty	No cartridge is connected (condition other than removal of cartridge during DMFC normal operation) DMFC state transition -Operation OFF → Warmup = NG (no transition from Operation OFF)
	Abnormal State	Fuel cartridge and peripheral circuits are abnormal (error is canceled by detecting absence of fuel cartridge) -System power supply = NG -LIB charge = NG
DMFC (Operation state)	Operation OFF	Auxiliary mechanism is OFF, and DMFC is OFF -System power supply = NG -LIB charge = NG
	WarmUp	Auxiliary mechanism is ON, but DMFC cannot guarantee rated output -System power supply = NG -LIB charge = NG
	Operation ON	Auxiliary mechanism is ON, and DMFC can guarantee rated output -System power supply = OK -LIB charge = OK
	Abnormal state	DMFC and its peripheral circuits are abnormal (error is canceled by starting operation of DMFC) -System power supply = NG -LIB charge = NG

FIG. 4B

	State	Definition
LIB	Over discharge 1	Due to over discharge detected state by dedicated IC, discharge path and FET switch are OFF -Microcomputer power supply = NG -Auxiliary mechanism power supply = NG -System power supply = NG -LIB power supply = OK
	Over discharge 2	Discharge path and FET switch are ON, but LIB battery voltage is Low -Microcomputer power supply = OK -Auxiliary mechanism power supply = NG ··· LIB cannot start DMFC operation -System power supply = NG -LIB power supply = OK
	LowBat	Remaining battery amount required for system power supply cannot be guaranteed -Microcomputer power supply = OK -Auxiliary mechanism power supply = OK ··· LIB can start DMFC operation -System power supply = NG -LIB power supply = OK

FIG. 5A

	Normal	Remaining battery amount required for system power supply can be guaranteed (not fully charged state) -Microcomputer power supply = OK -Auxiliary mechanism power supply = OK -System power supply = OK -LIB power supply = OK
	FullBat	Remaining battery amount required for system power supply can be guaranteed (fully charged state, not charge ON) -Microcomputer power supply = OK -Auxiliary mechanism power supply = OK -System power supply = OK -LIB power supply = NG
	Overvoltage	Charge is inhibited due to overvoltage detection (abnormal state is not set, and only charge is inhibited) -Microcomputer power supply = OK -Auxiliary mechanism power supply = OK -System power supply = OK -LIB power supply = NG
	Abnormal state	State of "abnormal charge current" or "abnormal discharge current without any load" (Originally, error is canceled by detecting absence of LID, but since LIB is incorporated, error is canceled by over discharge 1) -Microcomputer power supply = OK -Auxiliary mechanism power supply = NG -System power supply = NG -LIB power supply = NG

FIG. 5B

	Operation	Definition
LED (DMFC)	OFF	DMFC operation OFF
	Green blinking	During DMFC WarmUp operation
	Green ON	DMFC operation ON ··· DMFC can supply electric power (system, LIB charge, auxiliary mechanism)
	Orange blinking	Power supply abnormality
LED (LIB)	OFF	(DMFC operation OFF) or (LIB power supply abnormality) or (LIB overvoltage)
	Orange blinking	(Other than "OFF" condition) and (LIB = over discharge 1 or over discharge 2 or LowBat state)
	Orange flash	(Other than "OFF" condition) and (LIB = over discharge 1 or over discharge 2) and (DMFC power switch ON)
	Orange ON	(Other than "OFF" condition) and (LIB = Normal state)
	Green ON	(Other than "OFF" condition) and (LIB = FullBat state)

FIG. 6

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Atty: Dale S. Lazar/nlh

Appln. No: UNKNOWN Date: February 27, 2004

Inventors: AKIHIRO OZEKI ET AL.

Title: ELECTRONIC APPARATUS AND SUPPLY POWER SETTING METHOD FOR THE APPARATUS

24

☒ Utility Transmittal

☒ Application Data Sheet

38 No. of Pages Application (Spec + Claim(s) + Abstract)

20 No. of Numbered Claims Only

1 No. of Priority Documents

13 No. of Sheets of Drawings (Fig(s) 1-22)

☒ IDS ☒ Appendix for Cited Application

☒ PTO-1449 ☒ Cited Documents

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Other: Background Art Information Sheet

CURRENT DUE DATE: February 28, 2004

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TITLE OF THE INVENTION

ELECTRONIC APPARATUS AND SUPPLY POWER SETTING METHOD FOR THE APPARATUS

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is based upon and claims the benefit of priority from prior Japanese Patent Application No. 2003-053051, filed February 28, 2003, the entire contents of which are incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a battery managing technique employed in an electronic apparatus on which a plurality of types of battery can be simultaneously mounted.

2. Description of the Related Art

Recently, various types of battery-powered portable electronic apparatus, such as portable information terminals called personal digital assistants (PDAs) and digital cameras, have been developed and are widely used.

Further, great attention has been paid to environmental problems, and environment-friendly batteries are now being actively developed. As batteries of this type, direct methanol fuel cells (DMFCs) are well known.

In DMFCs, methanol is used as a fuel that reacts

with oxygen to generate electricity. DMFCs have a structure in which two electrodes, formed of porous metal or carbon, are connected via an electrolyte solution (see, for example, "All about Fuel Cells" by Hiroyuki Ikeda, published by Japan Jitsugyo Publishing, Co., Ltd., 2001/8/20, pp 216-217). Since DMFCs do not generate toxic substances, there is a strong demand that they be used in the above-mentioned electronic apparatus.

For example, a personal computer can now use various types of power sources, such as a conventional external AC power supply, a secondary battery (e.g., a lithium (Li) ion battery), and a DMFC.

Since a personal computer can use a DMFC, secondary battery and AC power supply, it is desirable for users to be able to set, by means of a simple operation, which power source to use, and when to use that power source. Further, when setting the source, it is desirable for users to be able to easily confirm the setting and the source currently in use. In other words, there is a strong demand for a user interface that can display the states of setting and use so that users can grasp it at a glance, and that permits users to make various types of setting by a simple operation.

Conventional electronic apparatuses do not provide such a user interface.

BRIEF SUMMARY OF THE INVENTION

According to an embodiment of the present invention, an electronic apparatus comprises a main unit, a first cell unit equipped with a fuel cell which can supply power to the main unit, a second cell unit equipped with a secondary battery which can supply power to the main unit, a setting unit configured to permit setting concerning supply of power from the first or second cell unit to the main unit, and a display unit displaying a state of supply of power from the first or second cell unit to the main unit, set by the setting unit.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

The accompanying drawings, which are incorporated in and constitute a part of the specification, illustrate an embodiment of the invention, and together with the general description given above and the detailed description of the embodiment given below, serve to explain the principles of the invention.

FIG. 1 is a perspective view illustrating the outward appearance of an electronic apparatus system according to an embodiment of the invention;

FIG. 2 is a perspective view illustrating the outward appearance of an electronic apparatus incorporated in the electronic apparatus system of FIG. 1, viewed when the lid is open;

FIG. 3 is a block diagram schematically

illustrating the structure of the electronic apparatus system;

FIG. 4 is a block diagram schematically illustrating the structure of a fuel cell unit incorporated in the electronic apparatus system;

FIG. 5 is a view illustrating a display example on the LCD of the electronic apparatus system;

FIG. 6 is a view illustrating a power-supply/charge state displayed by the electronic apparatus system;

FIG. 7 is a view illustrating information displayed by the electronic apparatus system when a cursor is put on a predetermined position;

FIG. 8 is a view illustrating a power-setting window displayed by the electronic apparatus system;

FIG. 9 is a view illustrating the remaining time till activation of a DMFC, displayed by the electronic apparatus system;

FIG. 10 is a view for explaining setting related to supply of power from a fuel cell unit or secondary battery unit to an electronic apparatus incorporated in the system, which can be performed by the electronic apparatus system;

FIG. 11 is a view illustrating a confirmation display example of the electronic apparatus system;

FIG. 12 is a view for explaining setting for charging a secondary battery unit, which can be

performed by the electronic apparatus system;

FIG. 13 is a view for explaining setting for, for example, supply of power during the activation of a DMFC, which can be performed by the electronic apparatus system;

FIG. 14 is a view for explaining setting for dealing with peak power using the DMFC, which can be performed by the electronic apparatus system;

FIG. 15 is a view for explaining setting for the charging control of an internal secondary battery, which can be performed by the electronic apparatus system;

FIG. 16 is a view for explaining setting for power supply control when the DMFC is connected to an AC cord, which can be performed by the electronic apparatus system;

FIG. 17 is a flowchart illustrating the control of the electronic apparatus system related to setting for power supply;

FIG. 18 is a flowchart illustrating, in detail, the control of various types of setting executed at step A7 of FIG. 17;

FIGS. 19A to 19C are view illustratings plain display examples displayed on a sub-LCD by the power supply controller of the electronic apparatus system;

FIG. 20 shows an information example displayed on the sub-LCD of the electronic apparatus system when

a cursor is put on the display;

FIGS. 21A to 21E are view illustratings other plain display examples displayed on the sub-LCD by the power supply controller of the electronic apparatus system; and

FIG. 22 is a view for explaining the case where the electronic apparatus system displays the power-supply/charge state by lighting an LED.

DETAILED DESCRIPTION OF THE INVENTION

An embodiment of the present will be described in detail with reference to the accompanying drawings.

FIG. 1 is a perspective view illustrating the outward appearance of an electronic apparatus system according to the embodiment of the invention.

As seen from FIG. 1, this electronic apparatus system comprises an electronic apparatus 1, such as a notebook-type personal computer, and a fuel cell unit 2 detachably attached to the back of the apparatus 1. The fuel cell unit 2 is a power supply device for supplying power to the electronic apparatus 1, and contains a DMFC for generating electrical energy by reacting, with oxygen, methanol contained therein as a fuel.

The electronic apparatus 1 and fuel cell unit 2 have their respective connectors to be connected, when necessary, to an AC cord for supplying AC power from an external power supply (AC power supply).

FIG. 2 is a perspective view illustrating the outward appearance of the electronic apparatus 1, viewed when the lid is open.

As seen from FIG. 2, the lid section of the electronic apparatus 1 is attached to the main unit of the apparatus by a hinge mechanism, so that it can be opened and closed. The lid section has a liquid crystal display (LCD) 141 in its inner wall surface. The main unit, to which the lid section is attached, has a sub-LCD 162 for plain display.

The main unit comprises a keyboard 151 for inputting characters, symbols, etc. to the input screen of the LCD 141, and a pointing device 152 for moving a mouse cursor displayed to point an arbitrary position on the LCD 141 and select the position. A secondary battery unit 3 that contains a repeatedly chargeable secondary battery is dismountably mounted in the bottom section of the main unit.

Thus, the electronic apparatus system can use, as power supply devices, the AC power supply that can be connected thereto via the AC cord connected to the electronic apparatus 1 or fuel cell unit 2, the fuel cell unit 2 attached to the apparatus 1, and the secondary battery unit 3 mounted in the apparatus 1. This electronic apparatus system can display that the current states of use of the power supply devices in an easily understandable manner, and can easily

switch the power supply devices from one to another. These will be described in detail.

FIG. 3 schematically shows the structure of the electronic apparatus 1.

As shown in FIG. 3, the electronic apparatus 1 comprises a CPU 11, RAM 12, HDD 13, display controller 14, keyboard controller 15 and power supply controller 16 connected to each other via a system bus.

The CPU 11 controls the entire electronic apparatus 1. For this purpose, the CPU 11 executes various programs stored in the RAM 12, such as the operating system, utility software, application software, etc.

The RAM 12 is a storage medium that serves as a work area for the CPU 11, and stores various programs executed by the CPU 11, and various types of data used when the programs are executed. On the other hand, the HDD 13 is a nonvolatile storage medium of a large capacity that serves as the auxiliary memory unit of the electronic apparatus 1, and stores a large number of programs and a large amount of data.

The display controller 14 controls the output of a user interface incorporated in the electronic apparatus 1, and controls the display on the LCD 141 of the image data processed by the CPU 11. The keyboard controller 15 controls the input of the user interface, and transmits the contents of operations, made by the

keyboard 151 or pointing device 152, to the CPU 11 via built-in registers.

The power supply controller 16 controls the supply of power to each section of the electronic apparatus 1. The controller 16 has a function for acquiring power from the AC power supply, fuel cell unit 2 and secondary battery unit 3, and transmitting/receiving various signals to/from a microcomputer 21, described later, of the fuel cell unit 2. Further, the power supply controller 16 contains a register 161 for setting how to use the AC power supply, fuel cell unit 2 and secondary battery unit 3. In response to an instruction from utility software (power supply management utility) executed by the CPU 11, the controller 16 updates various set values stored in the register 161. The register 161 also stores information indicative of the current power supply state of the entire electronic apparatus system. Referring to this information, the power supply management utility detects the current power supply state of the entire electronic apparatus system. The register 161 stores information concerning the operation state of the fuel cell unit 2 and the residual quantity of the secondary battery unit 3, as well as information as to whether or not the AC power supply is connected, whether or not the fuel cell unit 2 is connected, whether or not the secondary battery unit 3 is connected, etc.

The power supply management utility is a program that provides a user interface for displaying, on the LCD 141, the states of use of the AC power supply, fuel cell unit 2 and secondary battery unit 3, and permitting a user to input, on the LCD, various types of setting related to the states of use. The power supply controller 16 also has a function for displaying the states of use of the power supply devices on the sub-LCD 162 in a simple manner.

Furthermore, the power supply controller 16 can supply power to the fuel cell unit 2 and secondary battery unit 3.

FIG. 4 is a block diagram schematically illustrating the structure of the fuel cell unit 2.

As seen from FIG. 4, the fuel cell unit 2 comprises a microcomputer 21, DMFC 22, internal secondary battery 23 and charging circuit 24.

The microcomputer 21 controls the entire fuel cell unit 2, and transmits and receives various signals to/from the power supply controller 16 of the electronic apparatus 1. The microcomputer 21 also serves as a fuel-cell-unit-side power supply controller, and has a function for supplying the power of the DMFC 22 and internal secondary battery 23 to the electronic apparatus 1, and a function for supplying the DMFC 22 and internal secondary battery 23 with the power from the AC power supply and electronic

apparatus 1.

The DMFC 22 generates electrical energy by reacting, with oxygen, methanol contained therein as a fuel. The DMFC 22 has a slot that houses a detachable fuel tank 221. The DMFC 22 is a so-called auxiliary machine type DMFC that positively draws methanol from the fuel tank 221 or air using, for example, a pump (auxiliary machine). The DMFC 22 assigns part of the power generated to the operation of the auxiliary machine.

The internal secondary battery 23 is, for example, a lithium ion cell that can be repeatedly charged, during the activation of the DMFC 22, with the power needed for the auxiliary machine. In response to an instruction from the microcomputer 21, the charging circuit 24 charges the internal secondary battery 23 with the power generated by the DMFC 22 or supplied from the electronic apparatus 1. Further, the internal secondary battery 23 can be used to make up a shortfall in power when higher power than the output of the DMFC 22 is instantly required.

A description will be given of a user interface provided by the electronic apparatus system using the power supply management utility. FIG. 5 is a view illustrating a display example on the LCD 141 of the electronic apparatus 1.

In the case of FIG. 5, two types of application

software A and B are operating, and their respective windows A and B are displayed on the screen. Below the screen, an area called a task bar is provided, on which buttons are displayed for permitting a user to call the applications A and B when they are clicked.

An area called a task tray is provided at the rightmost portion of the task bar. Since the task tray displays, for example, an icon for indicating the state of the resident software operating in the background, it is also called an indicator area. In the electronic apparatus system, the power supply management utility operates in the background, and an icon (X) indicative of the activation of the power supply management utility is displayed on the task tray.

When the icon (X) displayed on the task tray is clicked by the pointing device 152, the power supply management utility requests the operating system to display, on the LCD 141, the power-supply/charge state display window as shown in FIG. 6. As well as the window display on the LCD 141 requested by the power supply management utility, the operating system controls all processes including report of operations on the display using the pointing device 152 to the management utility. Therefore, no further description is given of the control of the operating system.

As shown in FIG. 6, the power-supply/charge state display window displayed by the power supply management

utility displays marks A1, A2 and A3 that schematically express the electronic apparatus 1, fuel cell unit 2 and secondary battery unit 3, respectively. These marks will now be referred to as components (component images). The window also displays components A4, A23, A21 and A22. The component A4 indicates the AC power input from the electronic apparatus 1, the component A23 indicates the AC power input via the AC power supply connector of the fuel cell unit 2, and the components A21 and A22 indicate the DMFC 22 of the fuel cell unit 2 and the internal secondary battery 23, respectively.

The power supply utility accesses the register 161 of the power supply controller 16, thereby detecting the present power supply state of the entire electronic apparatus system, and expressing the detection result in the form of arrows (power supply image) between the components. In the example of FIG. 6, the arrows directed from the component A4 to the other components are displayed in a first form (i.e., displayed by broken lines). The arrows directed from the component A23 to the other components are also displayed in the first form. The first form means that the components A4 and A23 cannot supply power. From the first form, users instantly understand that no AC cord is connected to the electronic apparatus 1 and fuel cell unit 2.

The arrow directed from the component A2 to the

component A1 is displayed in a second form (i.e., displayed by a solid line, hatched). Furthermore, the arrow directed from the component A3 to the component A1 is displayed in a third form (i.e., displayed by a solid line, not hatched). These arrows indicate that the component A2 is currently supplying power to the component A1, and the component A3 can supply power to the component A1. From these arrows, users instantly understand that both the fuel cell unit 2 and secondary battery unit 3 are mounted, and the fuel cell unit 2 is now supplying power to the electronic apparatus 1. Instead of using hatching, the arrows may be made luminous or colored.

As described above, when the power supply device (the AC power supply, fuel cell unit 2, secondary battery unit 3) is supplying power to the electronic apparatus 1, the arrow directed from each component (A2, A3, A4) to the component A1 (indicating the electronic apparatus 1) is displayed by "a solid line", "hatched". Further, if the power supply device can supply power to the component A1 but is not supplying power thereto, the arrow directed from the power supply device to the component A1 is displayed by "a solid line", "not hatched". If the power supply device cannot supply power to the component A1, the arrow therebetween is displayed by "a broken line".

Furthermore, the arrows directed from the

components A21 and A22 of the component A2 to the component A1 are displayed in the combinations of the second and third forms. From this, it is understood, in the case of FIG. 6, that only the DMFC 22 in the fuel cell unit 2 is supplying power. Further, since the arrow directed from the component A22 indicative of the internal secondary battery 23 to the component A21 is displayed by "a solid line", "non hatched", it is understood that power can be supplied from the internal secondary battery 23 to the auxiliary machine of the DMFC 22. The arrow directed from the component A22 to the component A1 is also displayed by "a solid line", "non hatched", it is understood that power can also be supplied from the internal secondary battery 23 to the electronic apparatus 1. From the two arrows between the components A21 and A22 show that the internal secondary battery 23 is charged with the power of the DMFC 22.

Moreover, the two arrows between the components A2 and A3 are displayed in the third form, which shows that power can be supplied from the fuel cell unit 2 to the secondary battery unit 3 or vice versa, but no such supply of power is performed. Power is supplied from the secondary battery unit 3 to the fuel cell unit 2 when, for example, power is supplied to the auxiliary machine of the DMFC 22 in the unit 2 to activate the DMFC 2, or when power is supplied to charge the

internal secondary battery 23. On the other hand, power is supplied from the fuel cell unit 2 to the secondary batter unit 3 when, for example, the secondary battery unit 3 is charged with the power generated by the DMFC 22.

The component A1 displays plate A11 indicative of the operation mode in which the electronic apparatus 1 is operating. The operation mode determines the balance between the performance of the apparatus 1 and power saving. FIG. 6 shows that "normal" operation mode is now selected. The operation mode of the electronic apparatus 1 also includes "power saving" mode for suppressing power consumption (in which, for example, the brightness of the LCD 141 and the processing speed of the CPU are reduced), and "high-performance" mode (in which the brightness of the LCD 141 and the processing speed of the CPU are set maximum). The "normal" mode is positioned between the "power saving" mode and "high-performance" mode. In the "normal" mode, if the keyboard 151 or pointing device 152 is not operated during a predetermined period, the motor for driving the disks of an HDD 13 is kept OFF, and/or the brightness of the LCD is reduced.

The DMFC 22 of the fuel cell unit 2 can increase its output level in a stepwise manner in response to an instruction from the microcomputer 21. The power-supply/charge state display window can display the

output level using an indicator A211 displayed at the upper portion of the component A21 indicative of the DMFC 22. In this case, assuming that the DMFC 22 can change its output in three stages, the indicator A211 is divided into three cells that enable three output levels to be recognized. In the example of FIG. 6, two cells of the indicator A211 are hatched, which indicates that the middle output level is performed. If all cells of the indicator A211 are hatched, it indicates the high output level, whereas if only one cell is hatched, it indicates the low output level. Further, if no cells are hatched, the output level of the DMFC 22 is 0, i.e., the DMFC 22 is stopped.

When the mouse cursor is put by the pointing device 152 on one of the display areas of the components A1, A2 and A3, the power supply management utility displays the information as illustrated in, for example, FIG. 7. FIG. 7 shows a display example obtained when the mouse cursor is put on the component A21 of the component A2. This information indicates the operation mode, remaining amount, power supplies, remaining operation time in this order from the left. The remaining amount indicates the remaining fuel amount of the fuel tank 221. However, if the cursor is put on the component A1, the remaining amount section is blank. If the cursor is put on the component A3, the remaining amount indicates that of the secondary

battery.

As described above, the power-supply/charge state display window set by the power supply management utility displays the states of use of the fuel cell unit 2, secondary battery unit 3 and AC power supply so that users can understand them at a glance. Further, the power-supply/charge state display window enables the users to execute various types of setting related to the use of the power supply devices. A description will be given of various types of setting related to the use of the power supply devices.

(1) Display of Power Supply Setting Window

When one of the display areas of the components A1, A2 and A3 is clicked, the power supply management utility displays the power supply setting window as shown in FIG. 8. This window permits users to perform setting for power supply in the electronic apparatus system. This window displays the state of the currently used power supply (B1), and permits the users to perform setting as to the display/non-display of an icon (X) in the task tray (B2).

If a change occurs in the state of use of one of the power supply devices after the operation made on the power supply setting window, the power supply management utility updates the contents of the supply/charge state display screen in accordance with the change (the same can be said of various types of

setting described later).

(2) Start/Stop of DMFC 22

If the indicator A211 indicates that the output level of the DMFC 22 is 0, the DMFC 22 is stopped. At this time, users can request the activation of the DMFC 22 by clicking the display area of the component A21. Upon receiving the request, the power supply management utility supplies an instruction to activate the DMFC 22 to the microcomputer 21 of the fuel cell unit 2 via the power supply controller 16, and displays, on the LCD 141 as shown in FIG. 9, the time left before the activation of the DMFC 22 finishes. Conversely, users can stop the operating DMFC 22 by clicking the display area of the component A21.

(3) Output Level of DMFC 22

Users can request a change in the output level of the DMFC 22 by clicking the display area of the indicator A211. Upon receiving the request, the power supply management utility can change the output level of the DMFC 22 between the above-mentioned three levels (high, middle and low levels).

(4) Peak Shift

Users can perform setting related to peak shift by clicking the display area of the component A4 or A23. "Peak shift" means the shift of the power supply device from the AC power supply to a battery or fuel cell during, for example, the daytime in which power is

concentrically demanded. Upon receiving a request to perform this setting, the power supply management utility displays a window for setting the time zone in which the power supply device is shifted.

(5) Operation Mode

Users can change the operation mode by clicking the display area of the plate A11 in the component A1. Upon receiving a request to change the operation mode, the power supply management utility changes the operation mode. At this time, if the users request, the power supply management utility displays a window that shows the balance between the performance and power saving of the electronic apparatus 1 at the present operation mode (normal mode).

(6) Supply of Power from the Fuel Cell Unit 2, Secondary battery Unit 3 to Electronic Apparatus 1

Users can change the power supply device for the electronic apparatus 1 by clicking the display area indicated by arrow C1 or C2 shown in FIG. 10. At present, power is supplied from the fuel cell unit 2 to the apparatus 1. If the display area of arrow C2 is clicked, the power supply management utility displays the confirmation window shown in FIG. 11 to make the users confirm the switching of the power supply device, and then switches the power supply device to the secondary battery unit 3.

(7) Charging of Secondary battery Unit 3

Users can select one of the AC power supply and fuel cell unit 2 as the power supply device for charging the secondary battery unit 3, by clicking the display area of arrow C3 or C4 shown in FIG. 12. If, for example, the display area of arrow C3 is clicked, the power supply management utility sets the fuel cell unit 2 as the power supply device for charging the secondary battery unit 3 with the power generated by the fuel cell unit 2.

(8) Supply of Power for Activation of DMFC 22

Users can select the power supply device for supplying power to the auxiliary machine of the DMFC 22 to activate the DMFC 22, by clicking the display area of C5, C6, C7 or C8 shown in FIG. 13. If, for example, the display area of arrow C7 is clicked, the power supply management utility sets the internal secondary batter 23 as the power supply device. The supply of power is finished when the DMFC 22 reaches a state in which it can output predetermined or more power. At this time, the power supply management utility permits the users to select one of the fuel cell unit 2 and the secondary battery unit 3 as the power supply device for activating the electronic apparatus 1. As a result, users can set the electronic apparatus system, for example, so that firstly, the secondary battery unit 3 is used to quickly activate the electronic apparatus 1, and then the fuel cell unit 2 is used to operate the

apparatus 1 after the DMFC 22 is activated.

(9) Dealing with Peak Power Using DMFC

Users can select whether or not to cover a shortfall in power using the power generated by the internal secondary battery 23, when higher power than the output of the DMFC 22 is instantly required. If this covering is not selected, the shortfall is made up by, for example, the power generated by the secondary battery unit 3.

(10) Charge of Internal Secondary battery 23

Users can control the charge of the internal secondary battery 23 using the DMFC 22 in the fuel cell unit 2, by clicking the display area of arrow C10 shown in FIG. 15. In the state shown in FIG. 15, the internal secondary battery 23 is being charged by the DMFC 22. If the display area of arrow C10 is clicked, the power supply management utility stops the charging. After that, if the display area of arrow C10 is clicked again, the power supply management utility resumes the charging.

Further, if the display area of arrow C11 is clicked, the power supply management utility is instructed to charge the internal secondary battery 23 with the power generated by the secondary battery unit 3. Similarly, if the display area of arrow C12 is clicked, the power supply management utility is instructed to charge the internal secondary battery 23

with the power supplied from the power supply connected to the fuel cell unit 2 via the AC cord.

(11) Power Supply Control of DMFC 22 during Connection of AC Cord

When the AC power supply can be used for the fuel cell unit 2 via the AC cord connected to the unit 2, users can select whether or not to charge the internal secondary battery 23 with the power from the AC power supply. Further, if the display area of arrow C14 is clicked, it is selected whether or not to supply power from the AC power supply to the electronic apparatus 1.

As described above, the electronic apparatus system provides a user interface that enables users to confirm the states of use of the fuel cell unit 2, secondary battery unit 3 and AC power supply. This user interface also enables the users to perform various types of setting related to the use of these power supply devices and related to the charging of the internal secondary battery 23.

FIG. 17 is a flowchart illustrating the control of the electronic apparatus system related to setting for power supply.

In the electronic apparatus system, an icon for power supply setting is displayed in the task tray area provided at the lower right end of the LCD 141 (step A1). When this icon is clicked (YES in step A2), the power supply management utility displays, in a window,

a power-supply/charge state to be edited (step A3).

Further, when a cursor is put on a predetermined position on the power-supply/charge state display window (YES in step A4), the power supply management utility displays information corresponding to the position as shown in FIG. 7 (step A5). Furthermore, when a predetermined position on the power-supply/charge state display window is clicked (YES in step A6), the power supply management utility performs setting corresponding to the clicked position (step A7).

When a request to close the power-supply/charge state display window is made (YES in step A8), the power supply management utility closes the window and again displays the icon (X) in the task tray display area.

FIG. 18 is a flowchart illustrating, in detail, the control of various types of setting executed at step A7 of FIG. 17.

Firstly, the power supply management utility displays a setup window for performing setting corresponding to the clicked position (step B1). If a request to change data is made in the setup window (YES in step B2), the power supply management utility determines whether or not such a change is possible, referring to, for example, values held in the register 161 (step B3).

If the change is possible (YES in step B4), the power supply management utility displays a confirmation window that permits users to confirm the execution of the change (step B5). On the other hand, if it is impossible (NO at step B4), the power supply management utility displays an error message (step B6). Further, if the execution of the change is requested (YES in step B7), the power supply management utility executes the change (step B8).

If a request to close the setup window is made (YES in step B9), the power supply management utility closes the setup window and again displays the power-supply/charge state display window.

So far, the power-supply/charge state display window displayed on the LCD 141 by the power supply management utility has been described. However, in the electronic apparatus system, the power supply controller 16 also can cause the sub-LCD 162 to display simple data related to the power-supply/charge state. FIG. 19 is a view illustrating plain display examples displayed by the power supply controller 16 on the sub-LCD 162.

Since the display area of the sub-LCD 162 is small, the power supply controller 16 displays thereon required minimum information by changing the positions of the components (the electronic apparatus 1, fuel cell unit 2 and secondary battery unit 3) in accordance

with their power-supply/charge states.

FIGS. 19A to 19C show plain display examples obtained when the AC cord is not connected, i.e., the electronic apparatus 1 is powered by a battery or fuel cell. FIG. 19A illustrates the case where the electronic apparatus 1 is powered by a battery or fuel cell. FIG. 19B illustrates the case where the secondary battery unit is charged with the power from the cell. FIG. 19C illustrates the case where the DMFC 22 is activated by the battery.

In the case FIG. 19A, since one of the fuel cell unit 2 or secondary battery unit 3 supplies power to the electronic apparatus 1, a component D1 indicative of the apparatus 1 is positioned in the middle position, and components D2 and D3 indicative of the fuel cell unit 2 and secondary battery unit 3, respectively, are positioned at the opposite sides of the component D1. Further, arrows E1 an E2 are attached to express the state where one of the fuel cell unit 2 and secondary battery unit 3 supplies power to the electronic apparatus 1. In the shown example, the fuel cell unit 2 is supplying power to the apparatus 1.

In the case FIG. 19B, since the fuel cell unit 2 supplies power to the electronic apparatus 1 and secondary battery unit 3, it is positioned in the middle position, and the apparatus 1 and unit 3 are

positioned at the opposite sides of the unit 2.

In the case FIG. 19C, since the secondary battery unit 3 supplies power to the electronic apparatus 1 and fuel cell unit 2 (i.e., the DMFC 22 of the unit 2), it is positioned in the middle position, and the apparatus 1 and unit 2 are positioned at the opposite sides of the unit 3.

The above-described manner of plain display employed for display on the sub-LCD 162 by the power supply controller 16 is also applicable to reduced display on the LCD 141 by the power supply management utility. Specifically, the manner of plain display can be also employed in the case where users want to display required minimum information on the required minimum area on the LCD 141 if the power-supply/charge state display window shown in FIG. 6 cannot be displayed all the time. In this case, when the mouse cursor is put on one of the components, information display can also be performed as shown in FIG. 20.

On the other hand, FIGS. 21A to 21E show plain display examples obtained when the AC cord is connected, i.e., the electronic apparatus 1 is AC-powered. FIG. 21A illustrates the case where the electronic apparatus 1 is powered by the AC power. FIG. 21B illustrates the case where the secondary battery unit 3 is charged with the AC power. FIG. 21C illustrates the case where the secondary battery unit 3

is charged with the power from the fuel cell unit 2, and the AC power is supplied to the electronic apparatus 1. FIG. 21D illustrates the case where the AC power is supplied to the electronic apparatus 1 and fuel cell unit 2. FIG. 21E illustrates the case where the DMFC 22 is activated by the secondary battery unit 3.

In the case where the AC cord is connected, the electronic apparatus 1, fuel cell unit 2 and secondary battery unit 3 are positioned in accordance with their power-supply/charge states too. Additionally, if no AC power is supplied to the fuel cell unit 2 and secondary battery unit 3, and one of these units is used in preference to the other, the one unit is positioned closer to the electronic apparatus 1 than the other.

In the case FIG. 21A, since the AC power is supplied from the AC power supply to the electronic apparatus 1, the arrow directed from a component D4 indicative of the AC power supply to the component D1 indicative of the apparatus 1 is displayed. In this case, the fuel cell unit 2 or secondary battery unit 3 does not operate.

In the case FIG. 21B, since the AC power is supplied to the electronic apparatus 1, and is also accumulated in the secondary battery unit 3, the arrows directed from the component D4 to the components D1 and D3 are displayed.

In the case FIG. 21C, since the AC power is supplied to the electronic apparatus 1, and the secondary battery unit 3 is charged with the power from the fuel cell unit 2, the arrow directed from the component D4 to the component D1 is displayed to indicate the supply of the AC power to the apparatus 1, and the arrow directed from the component D2 to the component D3 is displayed to indicate the charge of the secondary battery unit 3.

In the case FIG. 21D, since the AC power is supplied to the electronic apparatus 1, and to the auxiliary machine or internal secondary battery 23 of the DMFC 22 in the fuel cell unit 2, the arrow directed from the component D4 to the components D1 and D2 is displayed.

In the case FIG. 21E, since the AC power is supplied to the electronic apparatus 1, and the power from the secondary battery unit 3 is supplied to the auxiliary machine or internal secondary battery 23 of the DMFC 22 in the fuel cell unit 2, the arrow from the component D4 to the component D1 is displayed to indicate the supply of the AC power to the apparatus 1, and the arrow from the component D3 to the component D2 is displayed to indicate the charge of the fuel cell unit 2.

Although in the above-described embodiment, LCDs (such as LCD 141 and sub-LCD 162) are used as

display devices, the invention is not limited to them. The power-supply/charge state can also be displayed by, for example, lighting an Light Emitting Diode (LED).

For example, the same information display as the above can be realized by printing the components, arrows, etc. on the casing of the electronic apparatus 1 or fuel cell unit 2 as shown in FIG. 22, and burying LCDs in the portions needed to be displayed.

Additional advantages and modifications will readily occur to those skilled in the art. Therefore, the invention in its broader aspects is not limited to the specific details and representative embodiments shown and described herein. Accordingly, various modifications may be made without departing from the spirit or scope of the general inventive concept as defined by the appended claims and their equivalents.

WHAT IS CLAIMED IS:

1. An electronic apparatus comprising:

a main unit;

a first cell unit equipped with a fuel cell which can supply power to the main unit;

a second cell unit equipped with a secondary battery which can supply power to the main unit;

a setting unit configured to permit setting concerning supply of power from the first or second cell unit to the main unit; and

a display unit displaying a state of supply of power from the first or second cell unit to the main unit, set by the setting unit.

2. The electronic apparatus according to claim 1, wherein the setting unit displays, on the display unit, an image indicating the first and second cell units, and an image indicating the supply of power from the first or second cell unit.

3. The electronic apparatus according to claim 1, wherein the setting unit displays, on the display unit, information indicating which one of the first and second cell units is supplying power, and performs switching between the first and second cell units.

4. The electronic apparatus according to claim 1, further comprising:

a pointing device which can operating a mouse cursor displayed on the display unit,

and wherein:

the setting unit displays, on the display unit, a first image indicating the first cell unit, a second image indicating the second cell unit, a third image indicating the main unit, a first power supply image indicating supply of power from the first cell unit to the main unit, and a second power supply image indicating supply of power from the second cell unit to the main unit; and

the setting unit starts the supply of power from the first or second cell unit to the main unit, when the pointing device is operated to cause the mouse cursor to select the first or second power supply image.

5. The electronic apparatus according to claim 1, wherein:

the first cell unit can control an amount of output power of the fuel cell in stages; and

the setting unit can display the amount of output power of the first cell unit, and can change the amount of output power.

6. The electronic apparatus according to claim 1, further comprising: a power input unit configured to receive power from outside,

and wherein:

the setting unit displays which one of the first cell unit and the power input unit is charging the

secondary battery of the second cell unit, and determines which one of the first cell unit and the power input unit should charge the secondary battery.

7. The electronic apparatus according to claim 1, wherein:

the first cell unit has a chargeable/dischargeable secondary battery; and

the setting unit displays whether or not the secondary battery of the first cell unit is charged by the fuel cell, and starts and stops charge of the secondary battery of the first cell unit.

8. The electronic apparatus according to claim 1, wherein the setting unit displays whether or not the fuel cell is operating, and starts and stops power generation of the fuel cell.

9. The electronic apparatus according to claim 8, wherein the setting unit displays a time required for the fuel cell to reach a state in which the fuel cell can supply power to the main unit, when the fuel cell is instructed to generate power.

10. The electronic apparatus according to claim 1, wherein:

the first cell unit has a power input unit configured to input power from an outside; and

the setting unit displays whether or not the power input unit inputs power, and an amount of the input power, and executes setting related to supply of power

from the power input unit.

11. The electronic apparatus according to claim 3, further comprising:

a pointing device which can operating a mouse cursor displayed on the display unit,

and wherein:

the setting unit can display, on the display unit, a first image indicating the first cell unit, and a second image indicating the second cell unit; and

the setting unit displays a setup window for executing various types of setting related to the first and second cell units, when one of the first and second images is selected by the mouse cursor operated by the pointing device.

12. The electronic apparatus according to claim 1, wherein:

the first cell unit has a chargeable/dischargeable secondary battery; and

the setting unit executes setting as to whether or not power is to be supplied from the fuel cell and the secondary battery of the first cell unit to the main unit, if power consumed by the main unit is higher than maximum power generated by the fuel cell.

13. The electronic apparatus according to claim 1, wherein:

the first cell unit has an auxiliary mechanism used to supply fuel to the fuel cell, and a repeatedly

chargeable/dischargeable secondary battery; and

the setting unit performs setting as to which one of the secondary battery of the first cell unit and the second cell unit should supply power to the auxiliary mechanism during activation of the fuel cell.

14. The electronic apparatus according to claim 13, further comprising:

a pointing device which can operate a mouse cursor displayed on the display unit,

and wherein:

the setting unit can display, on the display unit, a first image indicating the first cell unit, and a second image indicating the second cell unit; and

power is supplied from the secondary battery of the first cell unit to the auxiliary mechanism when the first image is selected by the mouse cursor operated by the pointing device, and power is supplied from the second cell unit to the auxiliary mechanism when the second image is selected by the mouse cursor.

15. The electronic apparatus according to claim 2, wherein the setting unit displays, on the display unit, information indicating a current state of use of the first or second cell unit indicated by the first or second image, when the first or second image is selected by the mouse cursor operated by the pointing device.

16. The electronic apparatus according to

claim 15, wherein the information indicating the current state of use includes a remaining amount of fuel in the fuel cell.

17. The electronic apparatus according to claim 15, wherein the information indicating the current state of use includes a period of time, in which the main unit is operable, left after power is supplied to the main unit from the first or second cell unit.

18. The electronic apparatus according to claim 2, wherein the setting unit determines a position of the first or second image on a basis of states of use of the first and second cell units.

19. A computer comprising:

a computer main unit;

a first cell unit equipped with a fuel cell which can supply power to the computer main unit;

a second cell unit equipped with a secondary battery which can supply power to the computer main unit;

a power input unit configured to input power from an outside to the computer main unit;

a display unit displaying a first image indicating the first cell unit, a second image indicating the second cell unit, and a third image indicating the power input unit;

a pointing device which can operate a mouse cursor

displayed on the display unit; and

a control unit configured to supply power to the computer main unit from one of the first and second cell units when one of the first, second and third images is selected by the mouse cursor operated by the pointing device, the one of the first and second cell units corresponding to the selected one of the first to third images.

20. A power supply setting method for an electronic apparatus having a first cell unit equipped with a fuel cell and a second cell unit equipped with a chargeable/dischargeable secondary battery, and being operated by power from the first or second cell unit, the method comprising:

displaying respective current states of use of the first and second cell units on a display of the electronic apparatus when a first operation is performed; and

permitting, on the display, a second operation to be performed for various types of setting related to use of the first and second cell units.

ABSTRACT OF THE DISCLOSURE

An electronic apparatus according to the invention can be powered by a fuel cell unit and secondary battery unit. Power supply management utility executed by a CPU displays the states of use of the fuel cell unit and secondary battery unit. If a predetermined operation is performed in response to the displayed states, using a pointing device, the power supply management utility permits various types of setting related to the use of the fuel cell unit and secondary battery unit to be performed.

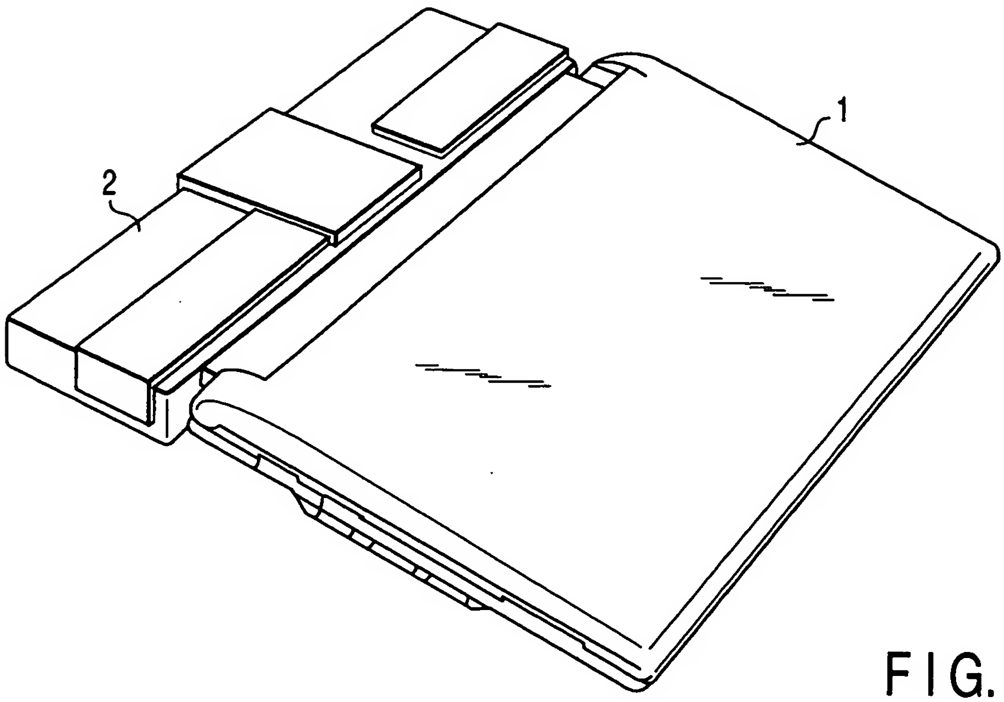


FIG. 1

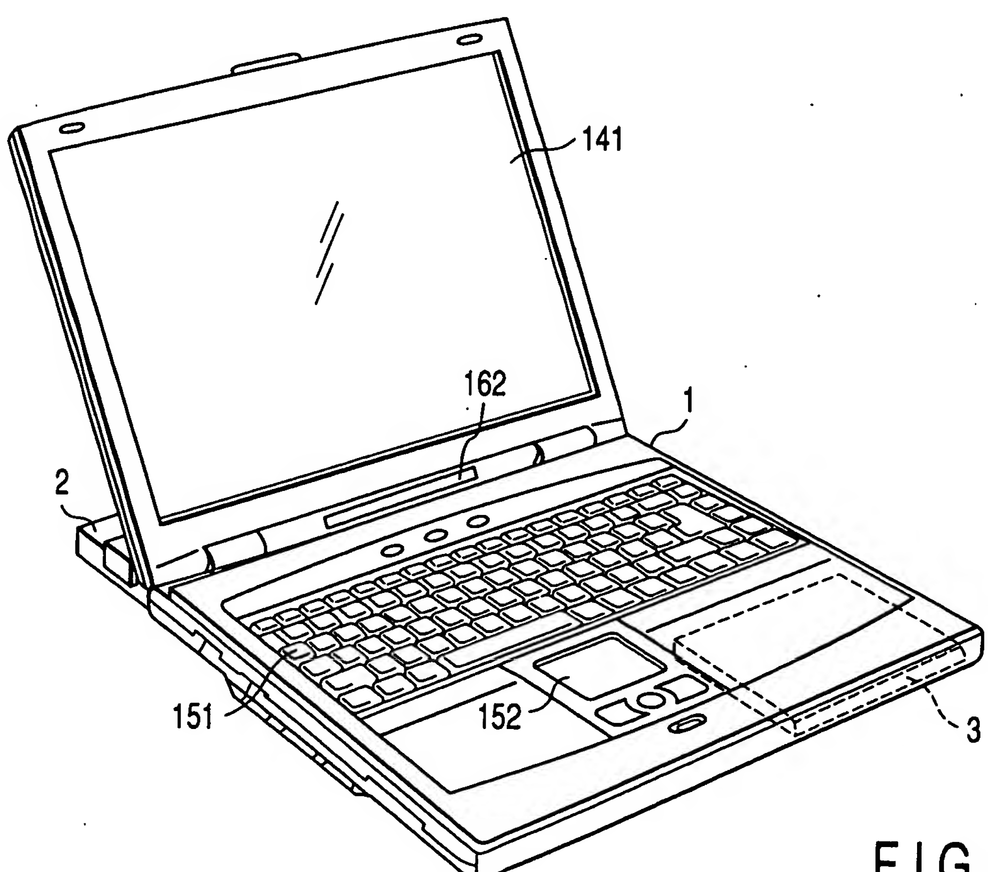


FIG. 2

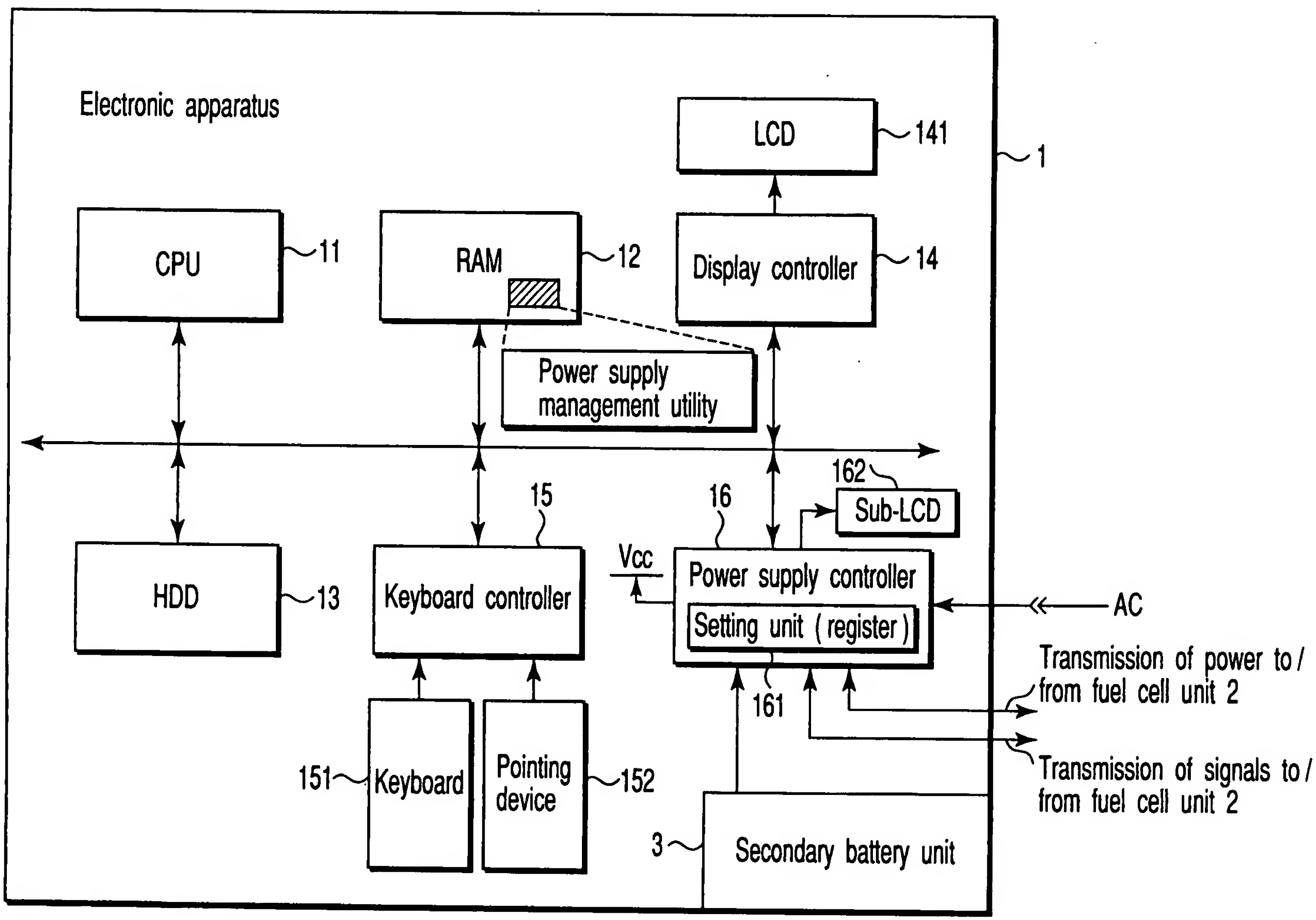
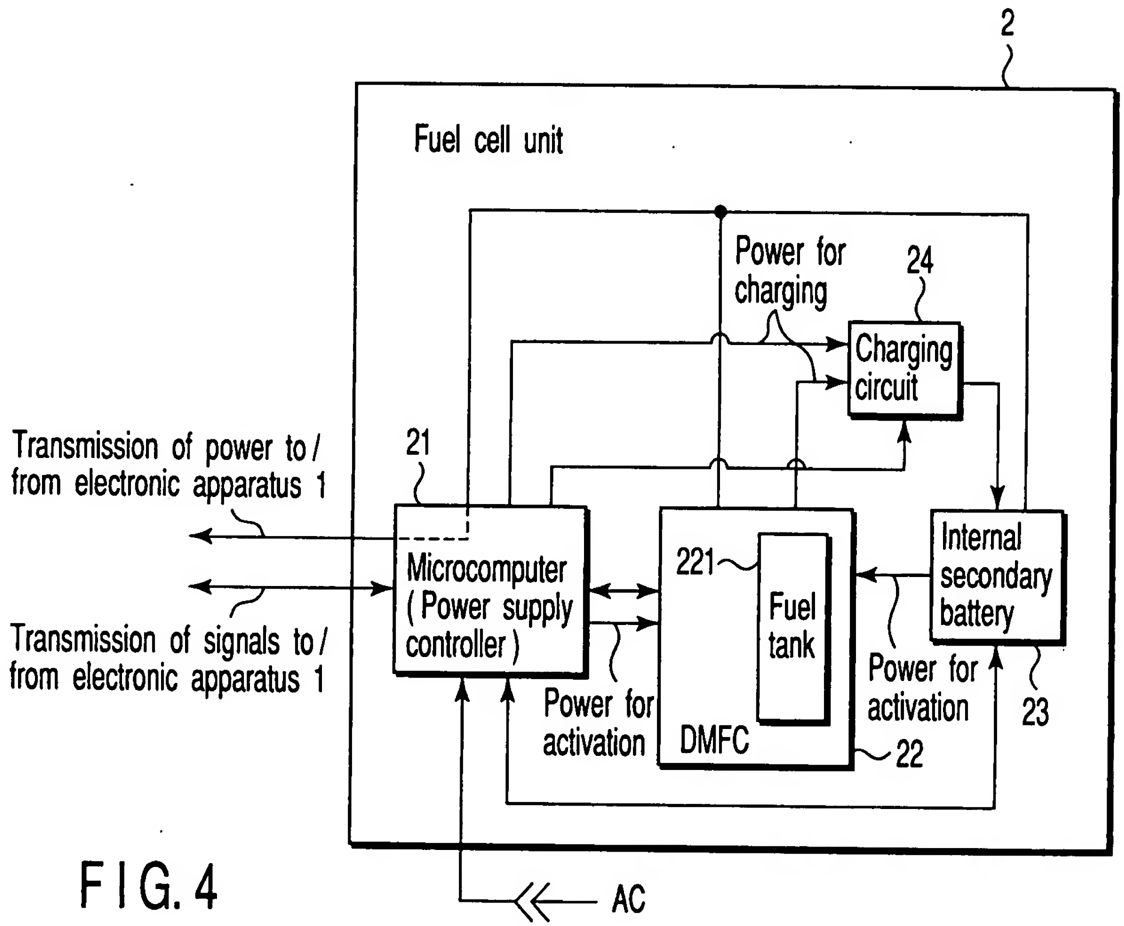
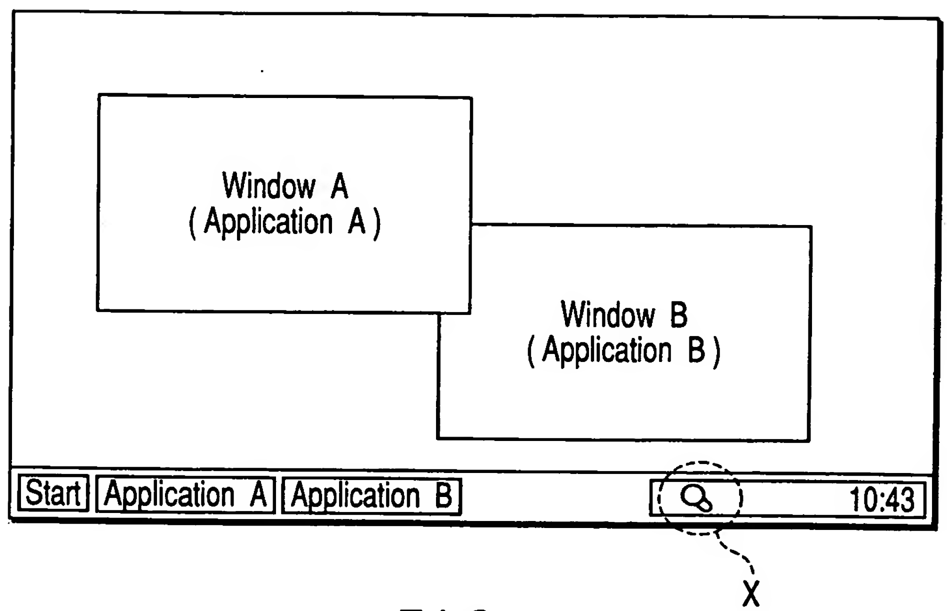

Electronic apparatus
CPU
11
RAM
12
LCD
141
Display controller
14
1
Power supply
management utility
HDD
13
Keyboard controller
15
16
162
Sub-LCD
Vcc
Power supply controller
Setting unit (register)
161
AC
Transmission of power to /
from fuel cell unit 2
Transmission of signals to /
from fuel cell unit 2
151
Keyboard
Pointing
device
152
3
Secondary battery unit

FIG. 3

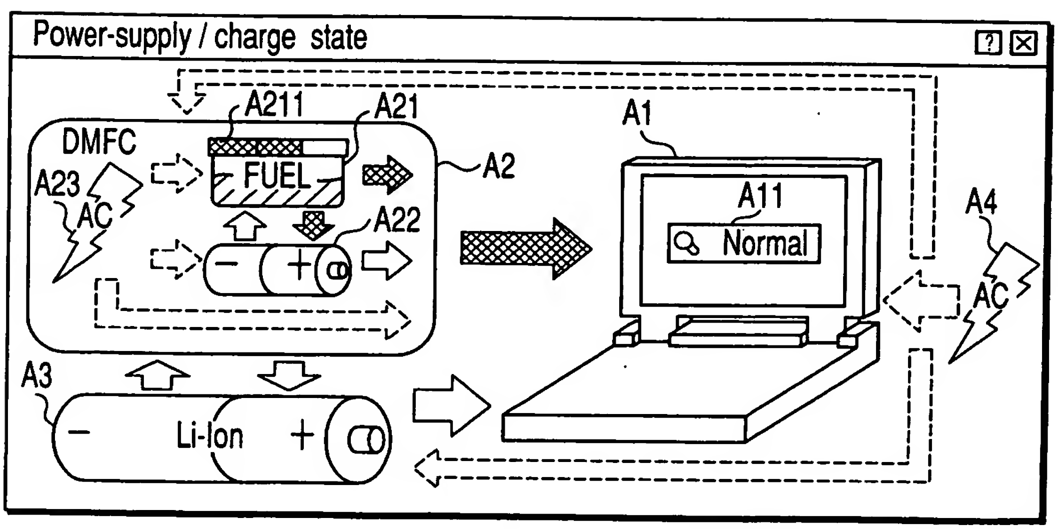

2
Fuel cell unit
Power for
charging
24
Charging
circuit
Transmission of power to /
from electronic apparatus 1
21
Microcomputer
(Power supply
controller)
Transmission of signals to /
from electronic apparatus 1
221
Fuel
tank
DMFC
22
Internal
secondary
battery
23
Power for
activation
Power for
activation
AC

F I G. 4



Window A
(Application A)
Window B
(Application B)
Start
Application A
Application B
10:43
X

FIG. 5



Power-supply / charge state
A211
A21
DMFC
A23
AC
FUEL
A22
A2
A1
A11
Normal
A4
AC
A3
Li-Ion

FIG. 6

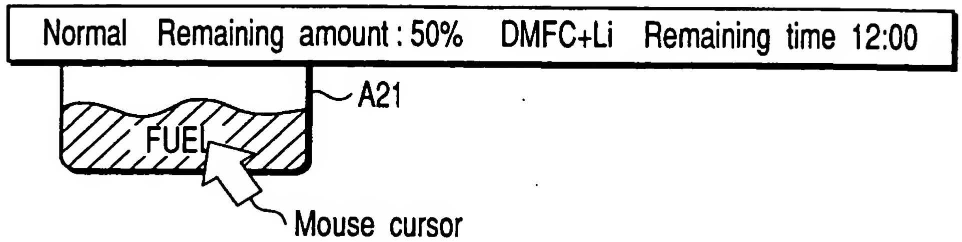

Normal Remaining amount : 50% DMFC+Li Remaining time 12:00
A21
FUEL
Mouse cursor

FIG. 7

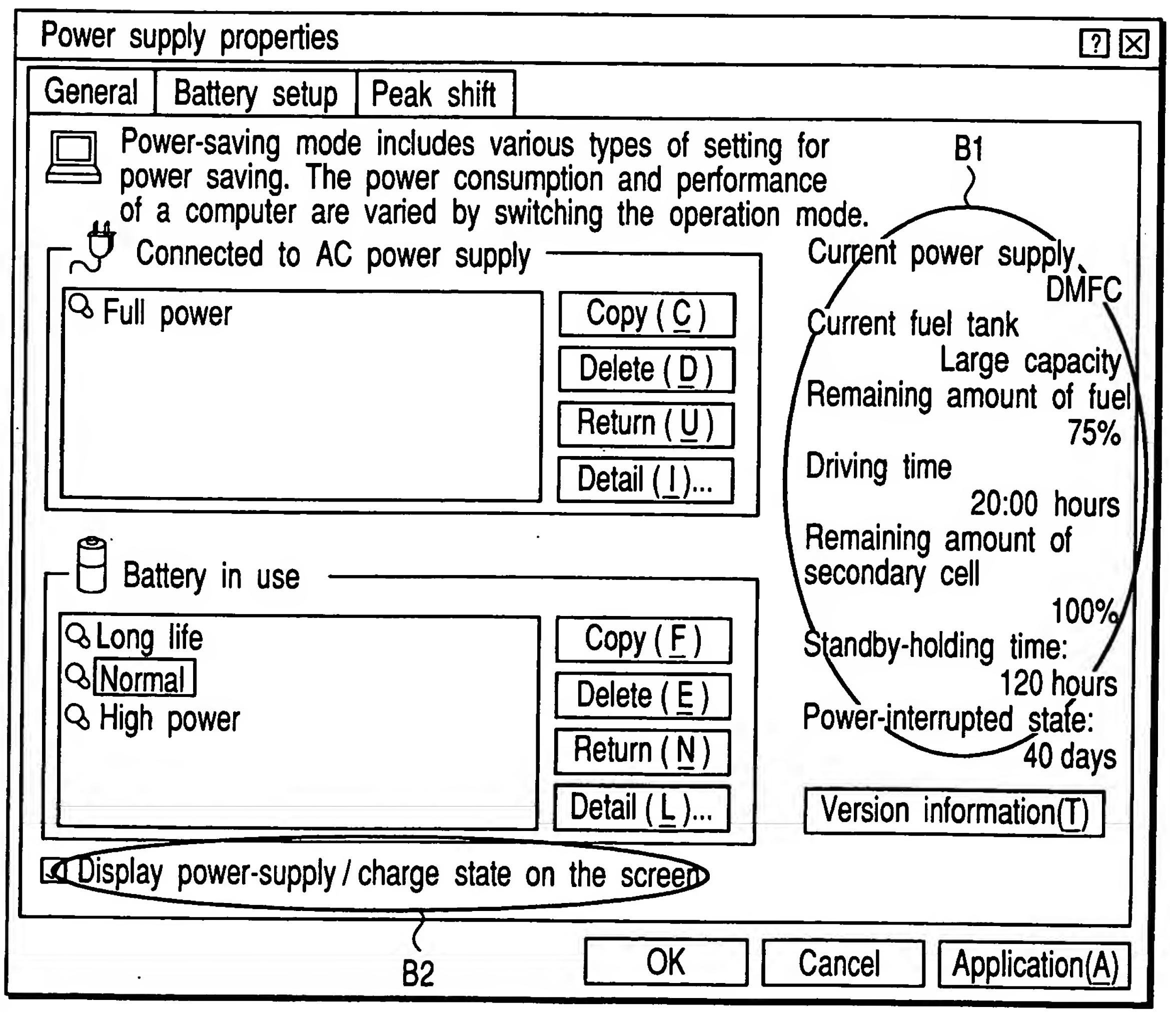
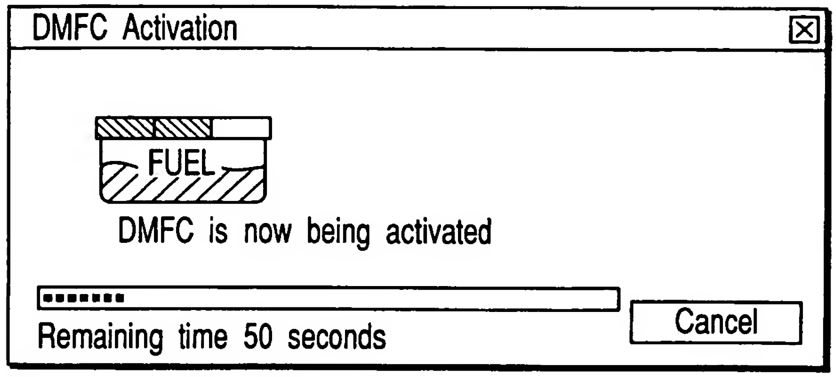
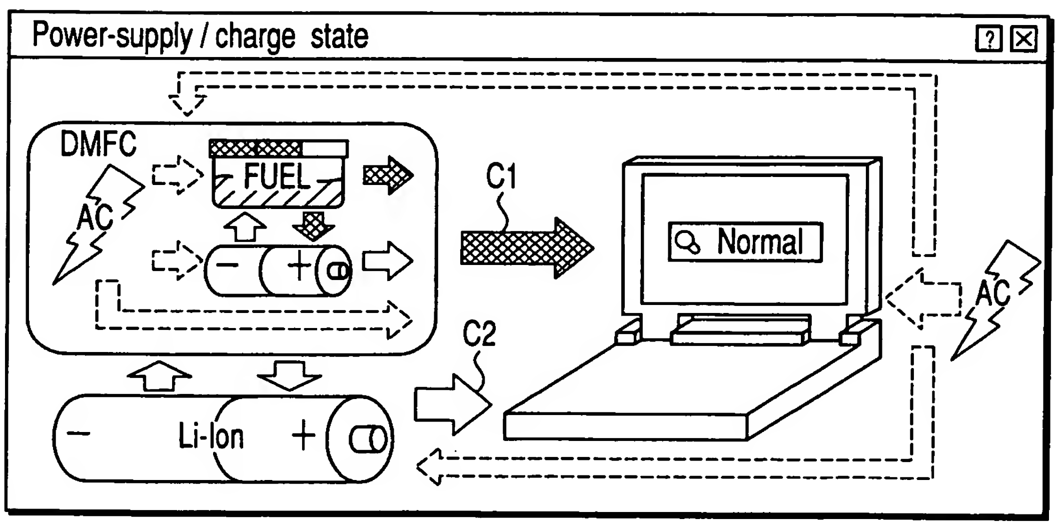

Power supply properties
General
Battery setup
Peak shift
Power-saving mode includes various types of setting for power saving. The power consumption and performance of a computer are varied by switching the operation mode.
Connected to AC power supply
Full power
Copy (C)
Delete (D)
Return (U)
Detail (I)...
Battery in use
Long life
Normal
High power
Copy (F)
Delete (E)
Return (N)
Detail (L)...
Display power-supply / charge state on the screen
B1
Current power supply
DMFC
Current fuel tank
Large capacity
Remaining amount of fuel
75%
Driving time
20:00 hours
Remaining amount of secondary cell
100%
Standby-holding time:
120 hours
Power-interrupted state:
40 days
Version information(T)
B2
OK
Cancel
Application(A)

FIG. 8


DMFC Activation
FUEL
DMFC is now being activated
Cancel
Remaining time 50 seconds

F I G. 9


Power-supply / charge state
DMFC
AC
FUEL
C1
Normal
C2
Li-Ion
AC

F I G. 10

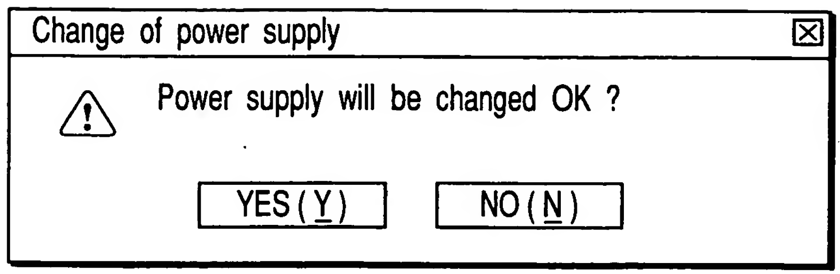

Change of power supply
Power supply will be changed OK ?
YES (Y)
NO (N)

FIG. 11

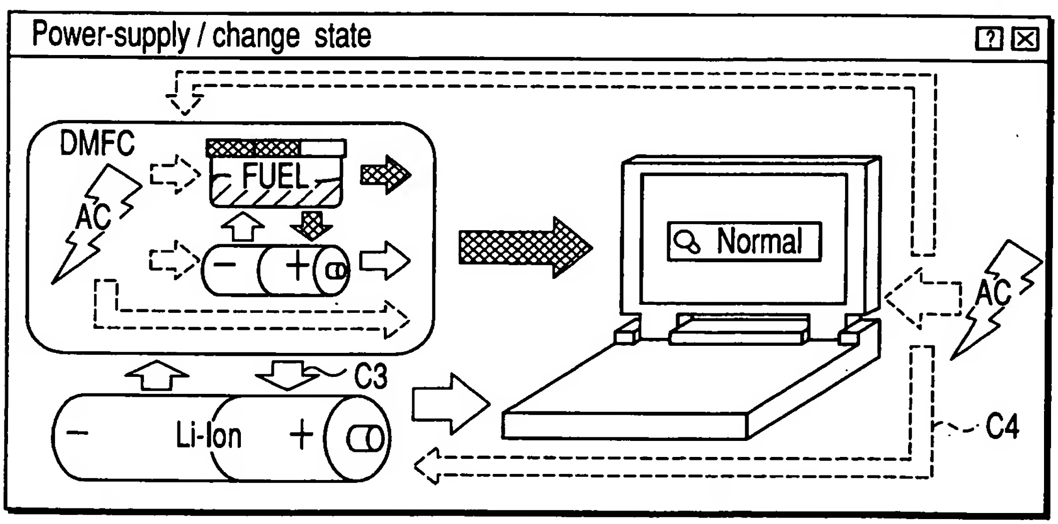

Power-supply / change state
DMFC
AC
FUEL
Normal
AC
C3
Li-Ion
C4

FIG. 12

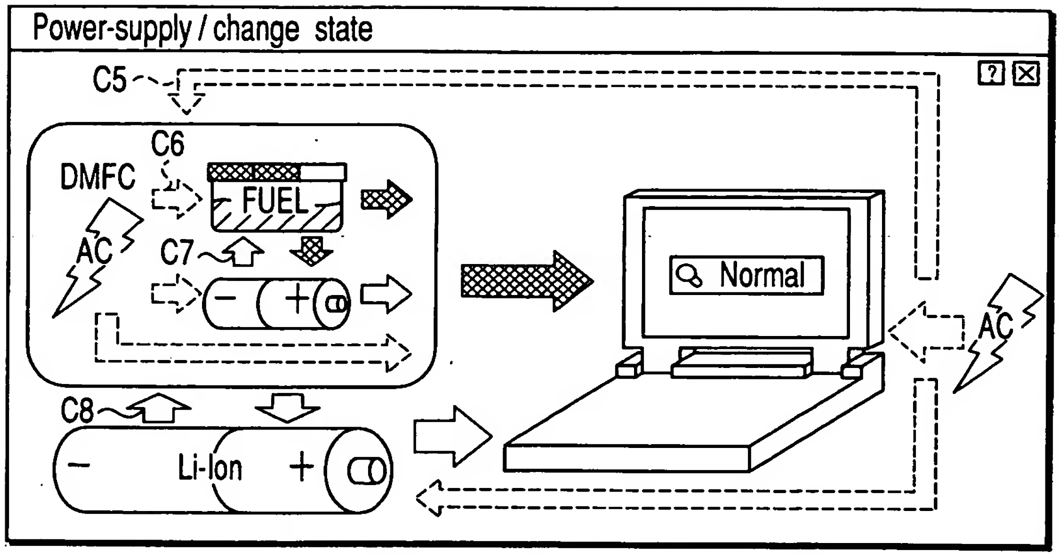

Power-supply / change state
C5
C6
DMFC
FUEL
AC
C7
Normal
AC
C8
Li-Ion

FIG. 13

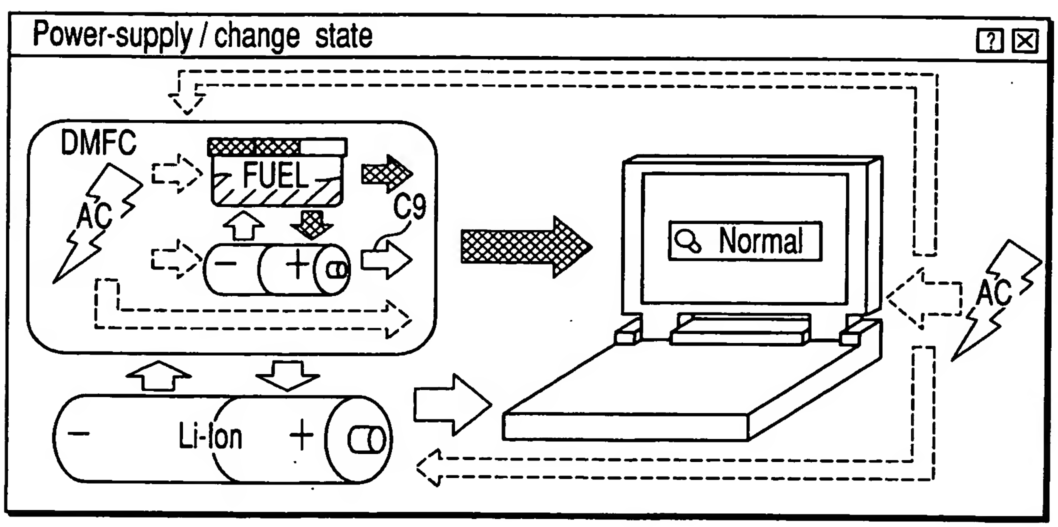
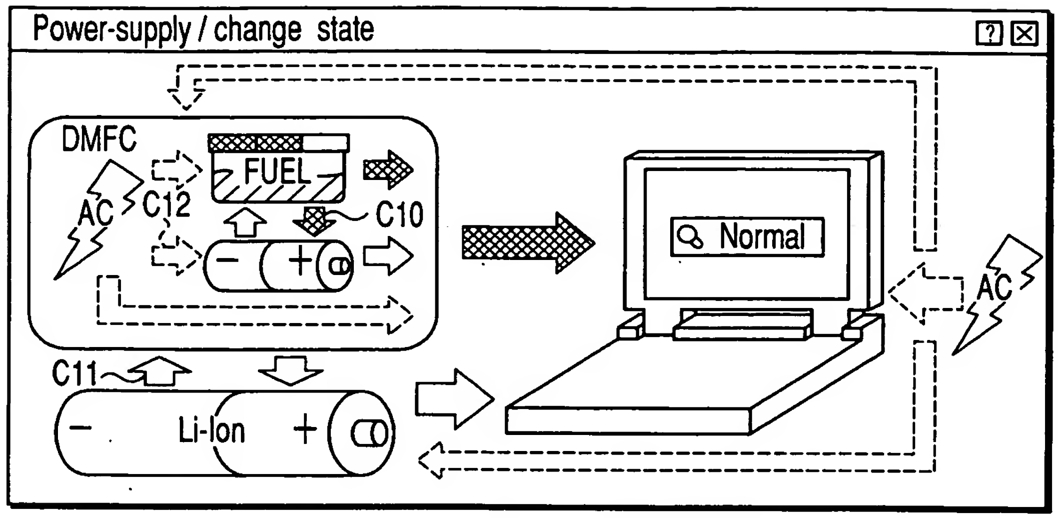
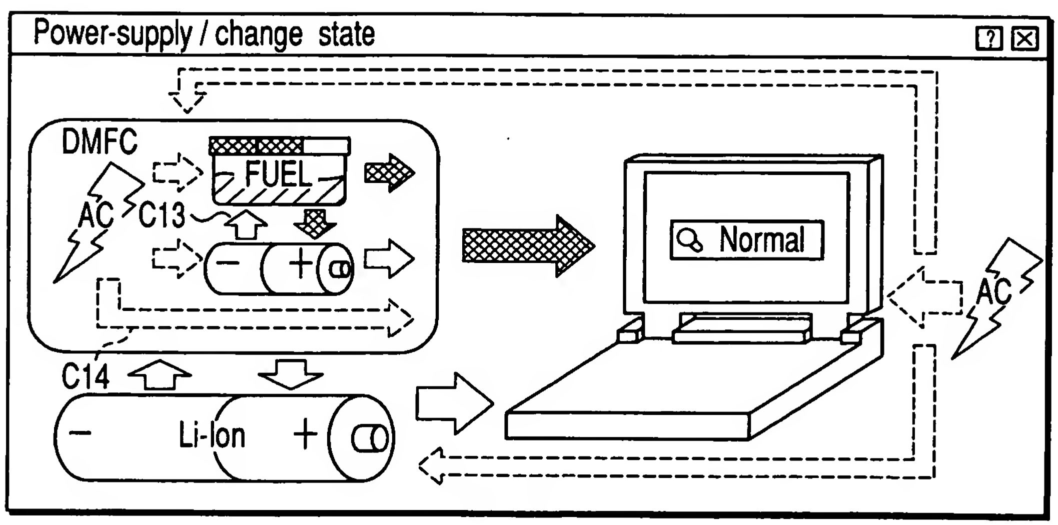

Power-supply / change state
DMFC
FUEL
AC
C9
Normal
AC
Li-Ion

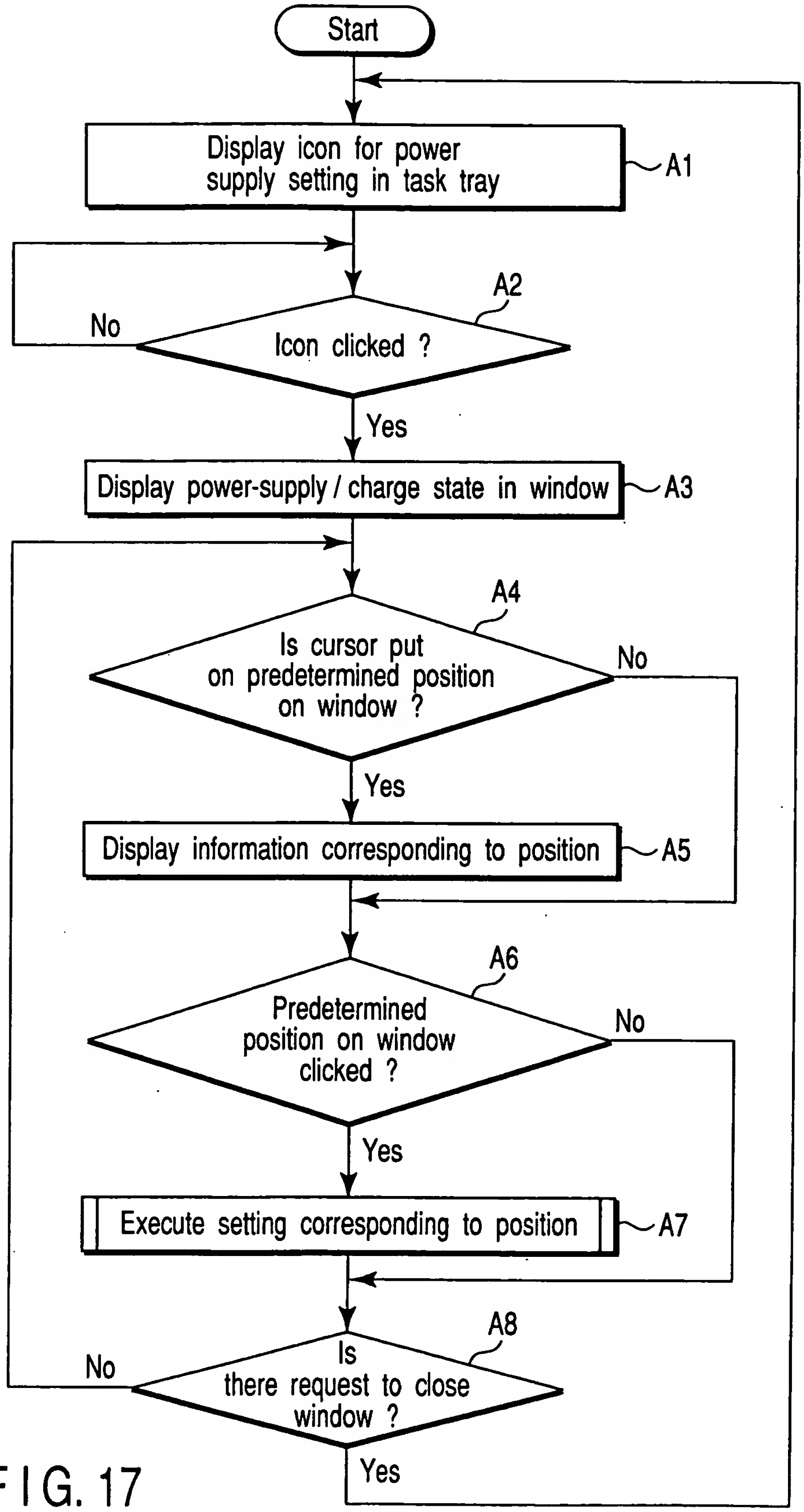
FIG. 14


Power-supply / change state
DMFC
FUEL
AC
C12
C10
Normal
AC
C11
Li-Ion

F I G. 15


Power-supply / change state
DMFC
FUEL
AC
C13
Normal
AC
C14
Li-Ion

F I G. 16



Start
Display icon for power supply setting in task tray
A1
Icon clicked ?
A2
No
Yes
Display power-supply / charge state in window
A3
Is cursor put on predetermined position on window ?
A4
No
Yes
Display information corresponding to position
A5
Predetermined position on window clicked ?
A6
No
Yes
Execute setting corresponding to position
A7
Is there request to close window ?
A8
No
Yes

F I G. 17

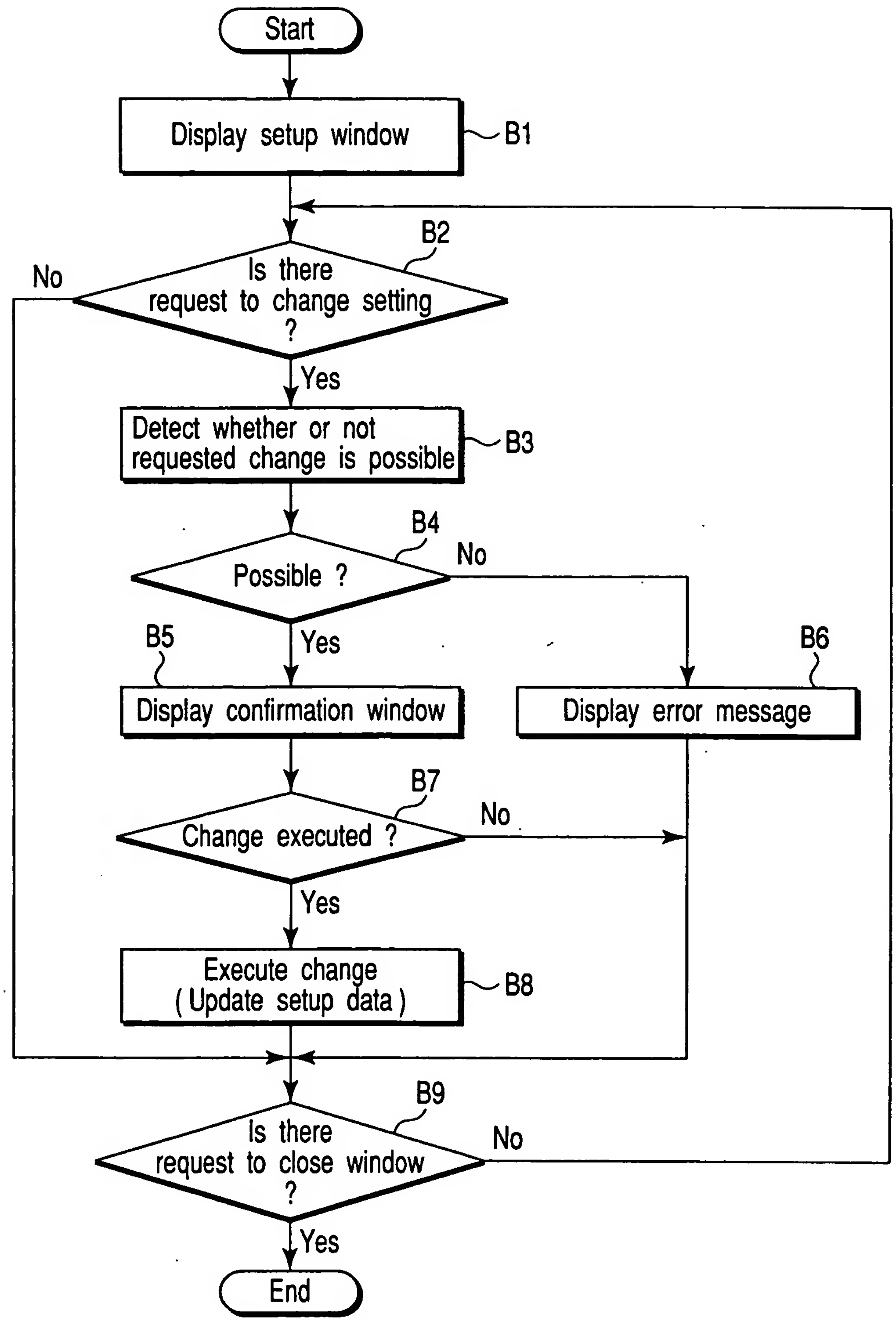

Start
Display setup window
B1
B2
Is there request to change setting ?
No
Yes
Detect whether or not requested change is possible
B3
B4
Possible ?
No
Yes
B5
B6
Display confirmation window
Display error message
B7
Change executed ?
No
Yes
Execute change (Update setup data)
B8
B9
Is there request to close window ?
No
Yes
End

FIG. 18

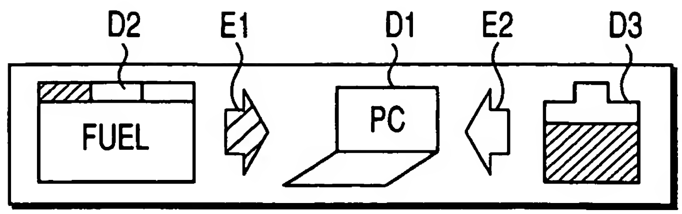


FIG. 19A

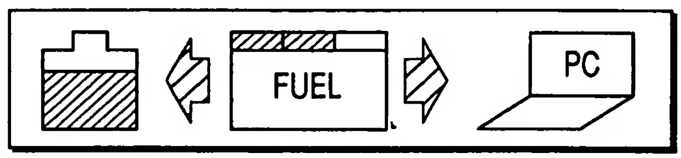


FIG. 19B

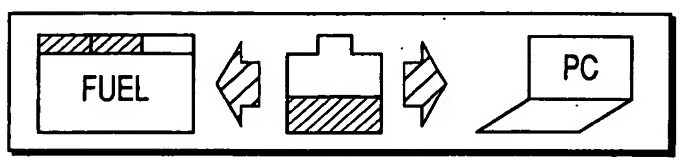


FIG. 19C

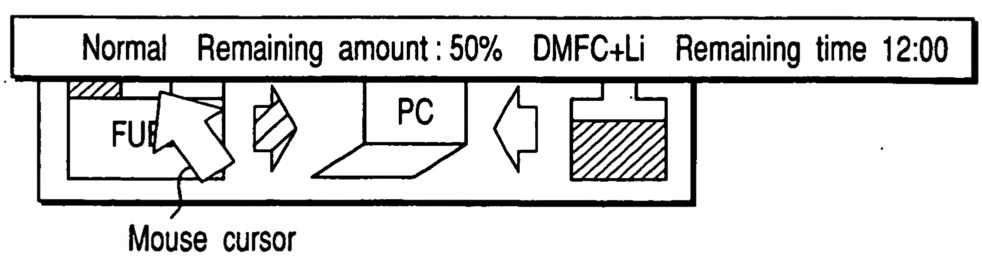
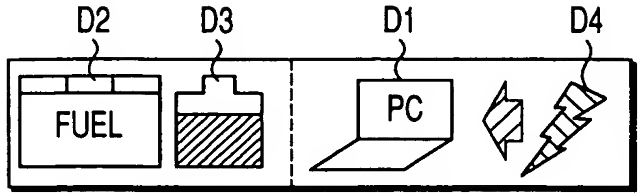
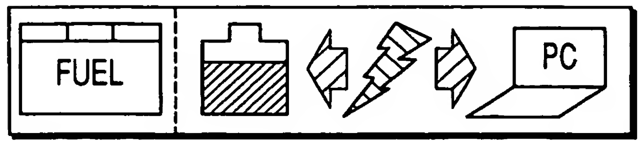


FIG. 20

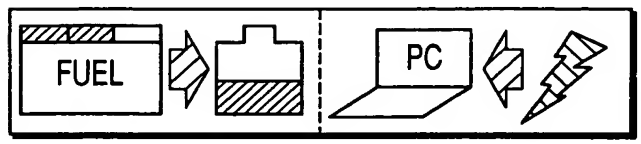
F I G. 21A



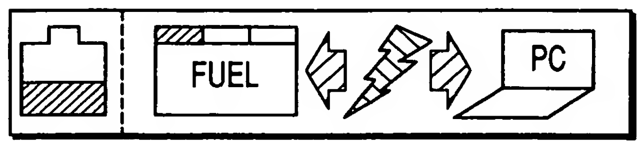
F I G. 21B



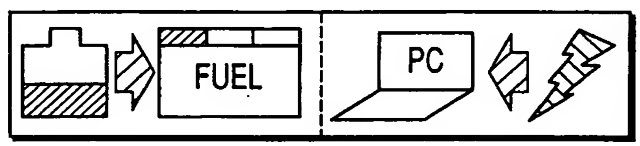
F I G. 21C

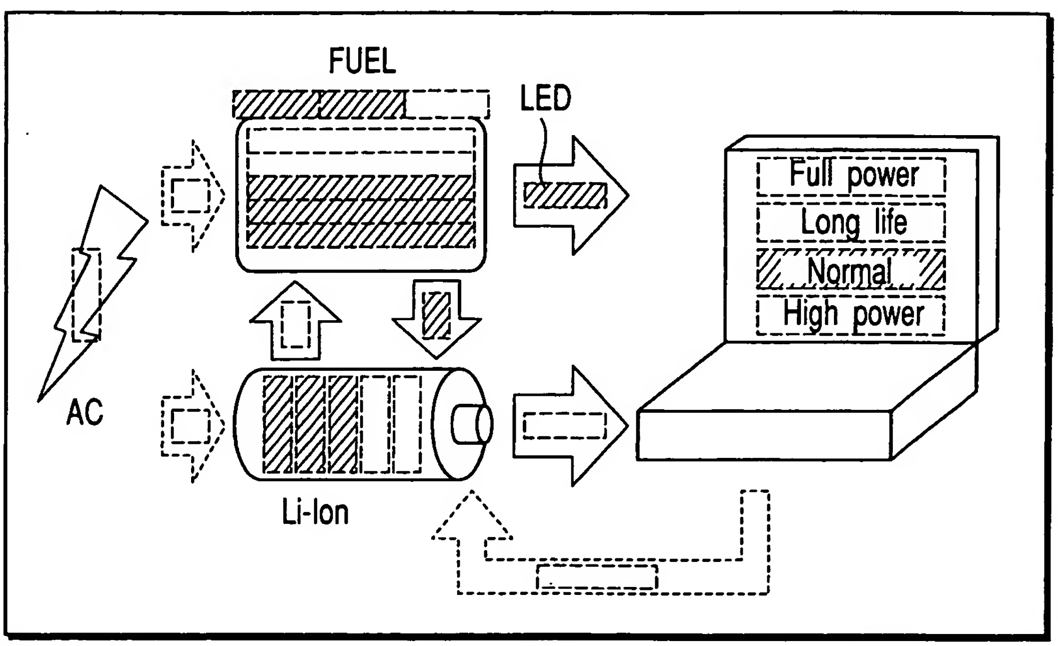


F I G. 21D



F I G. 21E





F I G. 22